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VOLUME XXX SAN FRANCISCO, JANUARY 4, 1913 NUMBER 1

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"Snowy Grandeur of Mt. Hood."

PORTLAND RAILWAY, LIGHT & POWER

BY ARTHUR H. HALLORAN.

Portland, Oregon, has enjoyed a solidity and rapidity of growth exceeded only by that of her electric power, light and transit facilities. Indeed, aside from the enterprise of her citizens and her advantageous situation at the junction of the Columbia and Willamette Rivers, where is poured the wealth of the great horn of plenty filled from the granaries, orchards and mines of Washington, Oregon and Idaho, there is no single factor which has contributed more to Portland's progress than electricity.

Generated by the tumbling waters of the Cascades, whose lofty peaks here find their culmination in the snowy grandeur of Mt. Hood, a short transmission gives to Portland the greatest abundance of hydroelectric power. Half as much more is ever ready for service from the great reserve steam plants in the city, by means of which the Portland Railway, Light & Power Company insures continuity of service to its patrons. Countries make railroads, railroads make towns, but power makes cities. A progressive power company constitutes one of the greatest assets of a community.

Such is the Portland Railway, Light & Power Company, which, with the companies of which it is the direct outgrowth, has served the people of Portland for over thirty years. Commencing in 1882, with the installation of a small Brush arc dynamo in Weidler's sawmill, it formed the nucleus for the United States Lighting Company, organized in 1885 to operate a small power plant under the Weidler franchise. In 1899 most of the equipment, which had been added to this original installation from time to time, was moved to the falls of the Willamette River at Oregon City, where power was generated and transmitted 14 miles to Portland by the Willamette Falls Electric Company. This company was reorganized in 1892 as the Portland General Electric Company, of which the present corporation was an outgrowth in 1906.

AS a detailed account of this early history appeared in these columns in August, 1905, the present article will be confined to a brief description of the great system.

The original plant on the east side of the Willamette at Oregon City, known as Station "A," has long since been mustered out of the service, though its wheels are still in use in one of the paper mills. Station "B" on the west side of the falls, is the veteran. Station "C," the first steam plant at Portland, has been merged with Station "E," as has likewise "F" with "L," while "D" has also been mustered out. Station "G" is the hydroelectric plant at Cazadero. "H" is a steam plant at Salem. "J" is a small hydroelectric plant at Silverton near Salem. "K" is at Boring, "L" in East Portland, "M" at River Mill on the Clackamas River below Cazadero, "N" at St. Johns, and "O" at Bull Run.

Station "B" at Oregon City.

These ten generating plants have a total rated capacity of 76,980 kw., five being hydroelectric plants with a capacity of 53,230 kw., and five steam driven, aggregating 23,750 kw. Over ninety per cent of the power used is hydraulically generated, the steam plants being used as auxiliaries at time of low water late in the summer.

The high tension transmission system has a total length of 307 miles, operated at 57,000, 33,000 and 11,500 volts. At convenient and strategic points, there are eighteen substations, lowering the voltage for distribution throughout the 800 square miles served, the population of this territory being close to 300,000.

The Portland Railway, Light & Power Company is a $25,000,000 corporation, the control of which is exercised by E. W. Clark & Co. of Philadelphia. C. M. Clark is chairman of the board of directors and J. S. Josselyn president. The vice-presidents are F. I. Fuller, M. S. Hopkins, E. W. Clark and H. L. Clark. At the time of writing it is the only company supplying electric power in any quantity to Portland.

In addition to supplying light and power, this company also operates a street railway system in Portland and interurban lines, connecting Portland with Estacada, Bull Run, St. Johns, Oregon City and Vancouver. Furthermore, it furnishes current for other electric railway companies, including the Oregon Electric, the United Railway and the Salem Street Railway Company. Salem is also supplied with gas.

BY far the oldest plant now operated by the company is Station "B" on the west bank of Willamette Falls at Oregon City, five of whose units have been in service since 1894. Seven other generators have been in operation since 1897 and two since 1903. These fourteen machines have a combined generating capacity of 7230 kw., power being transmitted fifteen miles to Portland at 10,000 volts. Novel features of this installation include the employment of a 33-cycle frequency and the dual wheel equipment for varying head.

The former is a relic of the time when the 60-cycle rotary converters had not been sucessfully developed for railway service. This odd frequency was selected as a compromise that would best take care of a mixed load power and lighting service.

The Willamette River, below the falls, is subject to a seasonal height variation of from 20 to 40 feet because of the back water from the flood-swollen Columbia during the spring thaw. The lower river rises as much as 20 ft., whereas there is little change in height above the falls. This necessitated the use of two sets of wheels to drive the main generators, ten of the units being direct connected to 42-in. turbines and belted to 60-in., the wheels being so arranged that they can be operated either individually or together according as the water can be most economically utilized. The smaller wheels are operated under heads varying from 30 to 40 ft., the larger at heads varying from 20 to 30 ft. The details of equipment are shown in the accompanying tabulated statement.

The generator leads pass to hand operated oil switches in concrete compartments at the rear of their respective generator panels, on which are mounted the operating handles for each switch. Thence the leads pass through disconnecting switches to the 10,000 volt buses on a gallery above and to the rear of the switchboard. From these buses two feeders are tapped to the double pole line down the west side of the river fifteen miles to Portland and one to the line on the east side. Another feeder is tapped to seven 750 kw. transformers which step the voltage up to 60,000 for transmission forty miles to Salem and to the substations of the Oregon Electric Railway enroute.

Station "B"—Oregon City.

Buildings: Concrete, timber truss roof, 246 ft. x 30 ft.

Hydraulic Equipment:

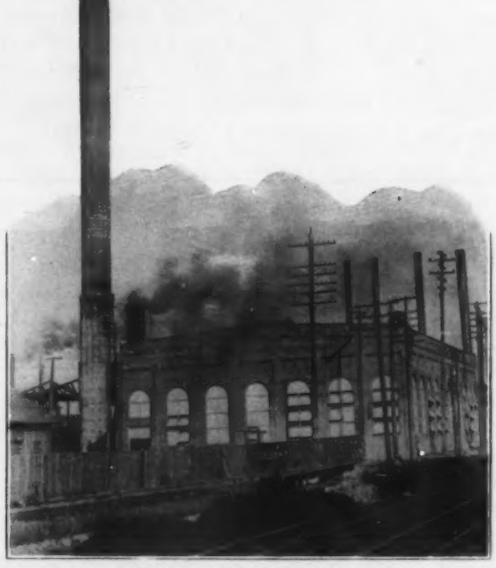
Ten 42 in. Victor turbines, cylinder gate, vertical shaft, Replogle governor, 30 ft. head—183 r.p.m. 6549 h.p. direct connected to a.c. generator.
Ten 60 in. Ditto, belted to above 30 ft. head, 126 r.p.m., 13,365 h.p.
Two 48 in. Ditto, direct connected to d.c. exciter, 30 ft. head, 159 r.p.m. 1552 h.p.
Two 51 in. McCormick turbines, cylinder gate, horizontal shaft, Replogle governors, direct connected to d.c. generator.
Two 15 in. Victor turbines cylinder gate, horizontal shaft, for driving circulating pumps.

Electrical Equipment:

Gen. Cap. 6,230 kw. Trans. Cap. 2.594 kw.
7-450 kw. 3-phase, 33-cycle generators, 10,000-volt, 200 r.p.m., revolving armature type, vertical shaft, G. E.
3-500 kw., 3-phase, 33-cycle, generators, 10,000 volt, 200 r.p.m., revolving field type, vertical shaft, G. E.
2-540 kw., 3-phase, 33-cycle generators, 10,000 volt, 143 r.p.m., revolving field typt, horizontal shaft, G. E.
1-500 kw., 3-phase, 60-cycle generator, 11,000 volt, 100 r.p.m., revolving field type, vertical shaft, Allis-Chalmers.
2-500 Kw. generators, 10 r.p.m., 600 volt, vertical shaft.
3-100 kw., 60-cycle, single-phase, transformers, 33,000/10,000-2300 volt.
2-75 light mercury arc rectifier set, air-cooled, single tube.
3-750 kw., 33-cycle transformers, 33,000/57,100-11,000 volt, connected delta.

EVER mindful of the requirements for continuity of electric service the company has provided several auxiliary steam plants in Portland to supplement the current supply from its more distant hydro-electric plants. The original site of Station "C" at the foot of Twenty-first street in North Portland is now occupied by Station "E." This plant has a total generating capacity of 14,050 kw., of which 15,000 h.p. is furnished by steam turbines.

The usual fuel is sawdust, hauled by the company's industrial railway from neighboring mills and conveyer-fed to Dutch ovens. The boilers are also arranged for oil burning. Condensing water is pumped from the Willamette River, on whose west bank the plant is situated, by means of three 16-in. vertical centrifugal pumps. Boiler feed water is obtained either from the condenser discharge or from the river and in emergency from the city mains.



Station "E" at Portland.

The switchboard stands on the main operating floor in front of the two tiers of concrete compartments housing the oil switches, which are operated by remote control from their respective panels. The generator leads are cambric-insulated cables, carried in ducts under the floor. The electrical protective and measuring apparatus is installed in the basement, being of General Electric make.

The frequency at this plant also is 33 cycles, being uniform with that at Station B, Oregon City, and two of the generators at Station G, Cazadero. All the other plants in the system generate 60-cycle alternating current. The lower frequency is used chiefly for railway service through the medium of rotary converters, and the higher for lighting. Direct current is used for power exclusively in all the downtown section of Portland.

This is one of the best-designed steam plants in the Pacific Northwest and is illustrative of typical practice in this section. The building is of reinforced concrete, as is also the 125 ft. stack.

The details of equipment are shown in the following table:

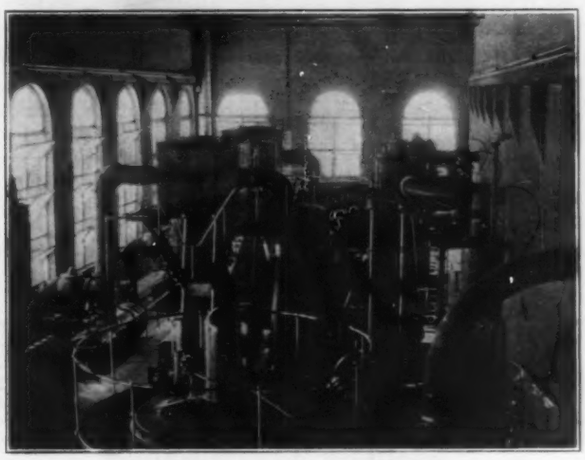
Station "E," Twenty-first and Nicolai.

New Building: Brick, steel truss roof, boiler room 148 ft. x 61 ft., with ell 36 ft. x 71 ft.; engine room 160 ft. x 46 ft., stack reinforced concrete, 230 ft. high, 12 ft. inside diameter.

Old Building: Corrugated iron, wooden truss roof; boiler room 100 ft. x 40 ft.; engine room 100 ft. x 120 ft.

Power Equipment:

Ten 520 h.p. Cahall water tube boilers, 175 lb. pressure, 2 boilers to a battery, 20 Dutch ovens for same, fitted with automatic sawdust stokers and oil burning apparatus. Six boilers fitted with Foster superheaters.
Four 125 h.p. tubular boilers, 100 lb. pressure fitted with Dutch ovens and automatic stokers for burning sawdust only.
Fourteen 100 h.p., ditto.
Two 2500 h.p. Curtis steam turbine, vertical type, 4 stage, 175 lb. pressure, 990 r.p.m., but operated at 1010 r.p.m.
Two 1500 h.p. Willamette Iron & Steel Works engines, marine type, vertical, cross-compound, 26 in. and 53 in. x 36 in., 130 r.p.m., 175 lb. pressure, condensing.
One 125 h.p. Ideal engine, horizontal type, high speed automatic, non-condensing (exciter set).
Two Worthington service condensers for vertical engines, 2300 sq. ft. cooling surface, each ⅛ in x 16 in. x 12 in., steam driven dry vacuum pump and 1/6 in. x 5½ in. x 6 ft. hotwell pump.
Two Worthington condensers for turbines 7500 sq. ft. cooling surface, each 1-10 in. x 18 in. x 18 in. dry vacuum pump and 1-7-½ x 8-½ in. x 10 ft., hotwell pump.
One 10,000 h.p. Curtis steam turbine, horizontal type, 1980 r.p.m. 175 lb. pressure.



Interior of Station "E."

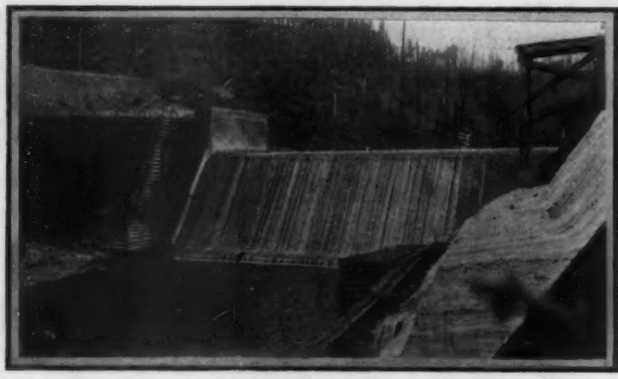
One Alberger counter current surface condenser 20,000 sq. ft. cooling surface.
One 10 x 30 x 24 Alberger dry vacuum pump.
One 4 in. Alberger centrifugal hotwell pump, driven by Curtis steam turbine.
One step bearing pump, 7½ in. x 2 in. x 6 in.
One 1600 h.p. twin Wheelock Corliss engine 32 in. x 60 in., 60 r.p.m., simple condensing, 100 lb. pressure.
One 1000 h.p. Allis Corliss engine, built by Risdon Iron Works, cross compound, condensing, 24 in. x 48 in., 78 r.p.m., 100 lb. pressure.

Pump House:

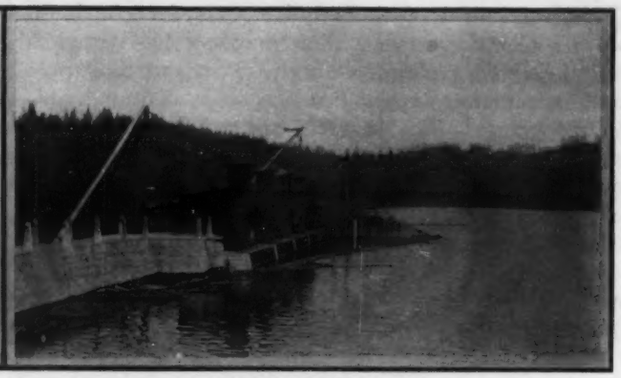
Three 3-phase, 220 kw. transformers, 10,000/440-volt, air cooled.
Two induction motors, 3-phase, 200 h.p., 33-cycle, 440 volt, 495 r.p.m.
One d.c. motor 600 volt, 125 r.p.m., variable speed.
Two 16 in centrifugal pumps, vertical, Platt.
One 24 in. centrifugal pump, vertical R. D. Wood.
One Worthington fire pump 16 in. x 9 in. x 12 in.

Electrical Equipment:

Gen Cap. 14,050 kw. Trans. Cap. 7558 kw.
Two 1000 kw. 3-phase, 33-cycle generators, 10,000 volt, revolving field type, horizonal shaft, 125 r.p.m.
Two 1500 kw. 3-phase, 33-cycle generator, 10,000 volt, revolving field type, vertical shaft, 990 r.p.m.
One 7500 kw., 3-phase, 33-cycle generator, 5500 volts, 1980 r.p.m., revolving field, horizontal shaft.
One 750 kw. 3-phase, 33-cycle generator, 10,000 volt, 333 r.p.m., revolving field type, horizontal shaft.
One 800 kw., d.c. generator, 550 volt, 120 r.p.m., horizontal shaft.
Six 375 kw., 33-cycle transformers, 10,000/2200-volt, used on 60-cycle lighting.
One 5114 kw., 33-cycle, 3-phase transformer.
One 75 light mercury arc set, all cooled type, double tube.
Two 400 kw. 3-phase, 33-cycle rotary converters, d.c., 650 volt, 666 r.p.m.
Six 150 kw. 3-phase, 33-cycle transformers, 10,000/404-volt.



Cazadero Dam.



Cazadero Forebay.

GENERATING 14,250 kw., the hydroelectric plant at Cazadero, on the Oregon Water Power division of the company's railway system, 37½ miles southeast of Portland, has been one of the mainstays of the system since it was put into service early in 1907. By means of diversion dam, flume, ditch and reservoir, water from the Clackamas River is delivered through five penstocks to as many turbines driving a.c. generators, whence it is discharged to the river channel.

The dam is a rock-filled log crib, double-planked, 176 ft. wide and 230 ft. long at the base, with 60 ft. rock-filled log bulk heads. The central spill-way of Ogee construction is 170 ft. long and 51 ft. high, delivering the water parallel with the water surface in the lower river and thus preventing erosion. The double row of supply gates, equipped for either hand or motor operation, are contained in a concrete bulkhead in the west side. This dam backs the water up the river about 2½ miles, giving an additional storage capacity of 6,000,000 cu. ft. when 3 ft. flash boards are used, or a total storage of nearly 30,000,000 cu. ft.

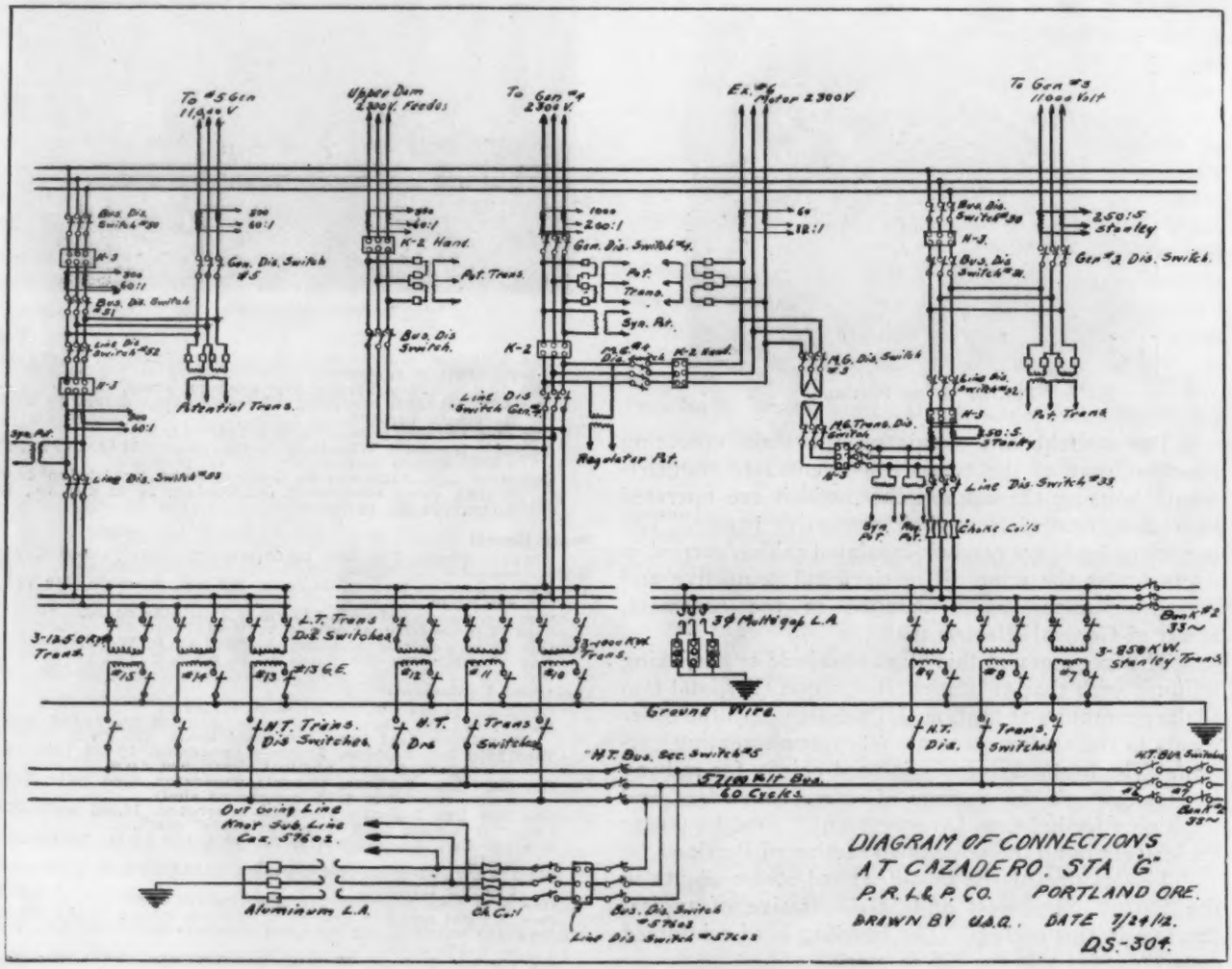


Diagram of Connections at Station "G."

Interior of Station "G."

Transformer House at Station "G."

The flume is 2800 ft. long, 18 ft. deep and 25 ft. wide, and discharges through a concrete outlet into an earth canal 3500 ft. long 35 ft. wide at the bottom, 55 ft. wide at the top and 18 ft. deep. The forebay reservoir covers 50 acres to a depth of 20 ft. At the lower end is a concrete retaining wall 49 ft. high and 280 ft. long with spill-way gates and one 9 ft. and four 8 ft. penstock openings provided with iron trash racks. The penstocks are 145 ft. long with 3/8 to 5/8 in. plates on the 8 ft. and 3/8 to 3/4 in. on the 9 ft. and supported at a 45 degree angle on a concrete web and cross wall structure.

The three original turbines were installed in 1907, one in 1909 and the last in 1910. They operate under a head of 138 ft. and in addition to the usual governors are equipped with a special over-speed cut out device. Three 75 kw. d.c. exciters are mounted on the extended shafts of the original wheels and another set is driven by a 150 h.p. Victor turbine.

The slate panel switchboard stands on the operating floor in front of the high-tension switching gallery, there being a panel for each generator and for each exciter, a line totaling panel and one for station circuits. The generator cable leads are carried to the motor operated oil switches on racks in the basement where the field rheostats are also placed, ventilation being secured by a shaft to the top of the building.

The transformer house is across the river from the generating station and contains the transformer compartments and switching room. Multiplex and aluminum cell lighting arresters are installed.

Station "G"—Cazadero.

Buildings: Brick, 50 ft. x 175 ft. x 30 ft. Concrete office and machine shop near; high steel girders, wood roof.

Power Equipment:

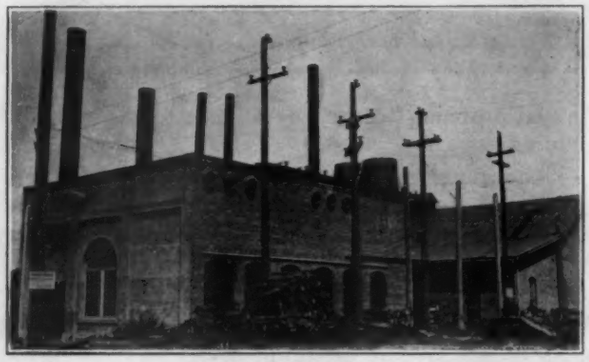
1 pair, 5500 h.p. Victor turbines, horizontal type, Lombard governor.
3 pair 5000 h.p. Victor 42 in. high-pressure turbines, horizontal type, Lombard governors.
1-6300 h.p. Victor turbine, horizontal type, Lombard governor.
1-150 h.p. Victor turbine horizontal type, for exciter set.

Electrical Equipment:

Gen. Cap. 14,250 kw. Trans. Cap. 14,850 kw.
2-2500 kw., 33-cycle, 3-phase Allis-Chalmers generators, revolving field type, horizontal shaft, 10,000 volt, 333 r.p.m.
1-2500 kw., 60-cycle, 3-phase, General Electric generator, 10,000 volt, revolving field type, horizontal shaft, 360 r.p.m., rewound from 6600 volts.
1-3750 kw., 3-phase, 60-cycle, General Electric generator, 10,000 volt, revolving field type, horizontal shaft, 360 r.p.m.
3-1000 kw., 3-phase, 60-cycle General Electric generators, 2300 volt, 400 r.p.m., revolving field type—all assembled on one horizontal shaft.
1-400 kw. 33-cycle rotary converter, d.c., 550 volt, 500 r.p.m.
3-150 kw., 33-cycle, single-phase, transformers, 10,000/400 volt.
9-850 kw., 33-cycle, single-phase transformers, 33,000/10,000 volt, 3 used on single 60-cycle.
3-1000 kw. 60-cycle, single-phase transformers, 33,000, 57,-100-11,000, 2300 volt.
3-1250 kw., 60-cycle, single-phase, transformers, 33,000/57,100-11,000/2300 volt.

Station "G" at Cazadero.

HALF of the plants in a great system such as this are often held in reserve to care for the possible disablement of other units generating power more economically. This is the case with Station "H" at Salem, which for years was the chief reliance of the company's Willamette Valley Division, being operated in conjunction with Station "J" at Silverton. But since the completion of the forty-mile transmission line in 1908 from Oregon City, it has been shut down and is used for relay purposes only.



Station "H" at Salem.

In addition to the usual service, Salem is also supplied with gas from the company's plant.

Station "H"—Salem.

Building: Brick, wood roof, wood trusses

Power Equipment:

2-100 h.p. water tube boilers, 100 lb. pressure, wood or oil burning furnaces.
6-100 h.p. tubular ditto.
1-500 h.p. Fulton Corliss condensing engine, 150 r.p.m.
1-350 h.p. Lane & Bodley condensing engine, 75 r.p.m.
1-350 h.p. Sioux City, condensing engine, 75 r.p.m.

Electrical Equipment:

Gen. Cap., 800 kw. Trans. Cap. 3745 kw., secondary gen. 1900 kw.
1-400 kw. d.c. generator, 600 volt, 150 r.p.m., horizontal shaft.
1-250 kw., 3-phase, 60-cycle generator, 2300 volt, 450 r.p.m., horizontal shaft.
1-150 kw. motor generator set, 2300/600 volt, 514 r.p.m., horizontal shaft, a.c. end, 3-phase, 2300 volt, 60-cycle, belt connected to engine.
1-400 kw. motor generator set, 2300/600 volt, 450 r.p.m. horizontal shaft, a.c. end, 3-phase, 2300 volt, 60 cycle.
1-1000 kw. frequency changer set, 10,000 volts, 33-cycle, 2300 volts, 60-cycle, 400 r.p.m.
1-500 kw. frequency changer set, 10,000 volt, 33-cycle, 2300 volt, 60-cycle, 400 r.p.m.
1-1000 kw. rotary converter, 6-phase, 33-cycle, 333 r.p.m., d.c., 600 volt.
2-30 kw. constant current transformers for a.c. lighting system.
3-750 kw., 33-cycle, single-phase, transformers, 33,900/57,000-11,000 volts.
2-150 kw., 60-cycle, single-phase transformers, 16,500-2300 volt connected open delta.
3-367 kw., 33-cycle, single-phase transformers, 500/10,000-430 volt.
1-75 light mercury arc rectifier set, oil-cooled type, 2 tubes.

JOINING Salem with Station "J" on Silver Creek, near the town of Silverton, are about eighteen miles of transmission line, which in conjunction with a line from Oregon City supplies the light and power necessities of this community. Station "J" is a 250 kw. hydroelectric plant which was built by the Union Light & Power Company in 1902, later being taken over by the Willamette Valley Company and finally sold in 1908 to the Portland Railway, Light & Power Company. Water is diverted from the creek by a 6 ft. dam with 63 ft. spill-way and thence conveyed to a 27 in. double runner, horizontal McCormick turbine, belted to a 250 kw. generator.

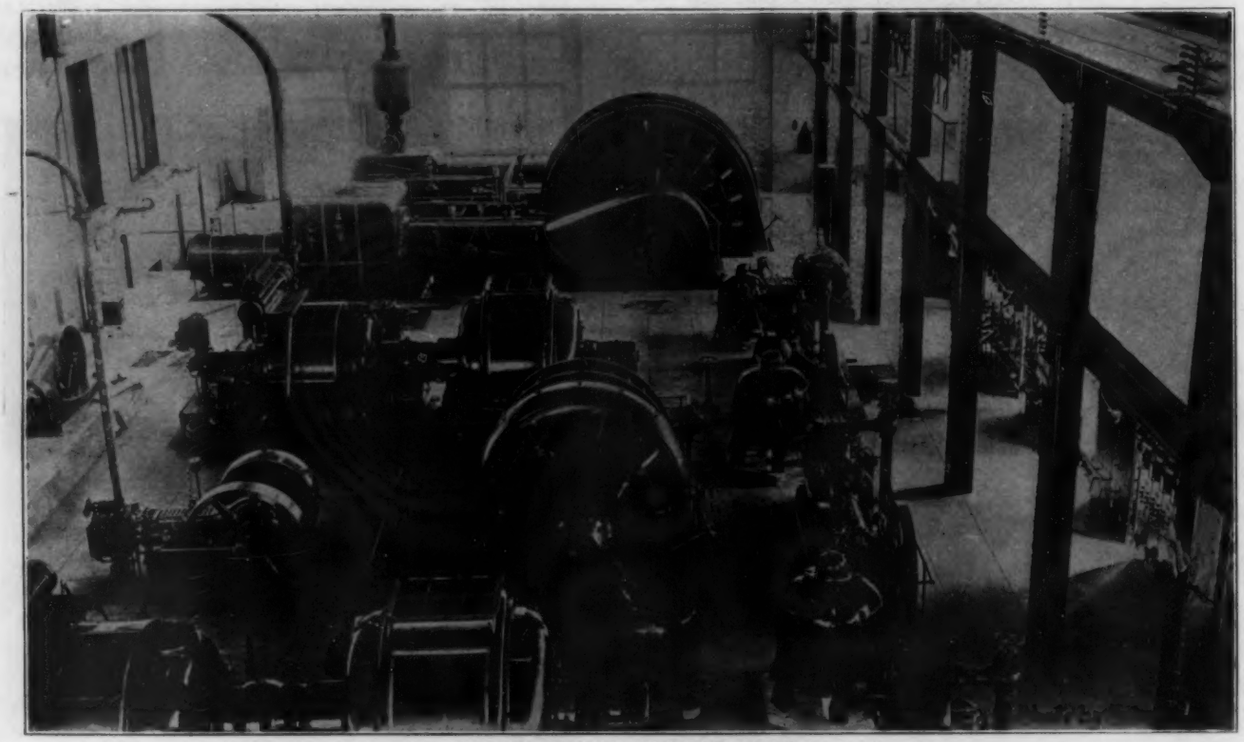
Station "J"—Silverton.

Building: Frame on rubble stone foundation, 60 x 66 ft.

Power Equipment: One low pressure open box, 27 in. McCormick turbine.

Electrical Equipment:

Gen. Cap. 250 kw. Trans. Cap. 300 kw.
One 250 kw., 3-phase, 60-cycle, Westinghouse generator, 2200 volt, 450 r.p.m., revolving armature type, horizontal shaft.
Two 150 kw., single-phase, 60-cycle, transformers, 16,500/2200 volt, connected open delta.



Interior of Station "L" at Portland.

KEEPING a steam plant in reserve is also practiced at Station "K," Boring, which is in regular use as a converter station for the Oregon Water Power Division of the company's railway system. The steam equipment installed in 1904 comprised a 500 h.p Hamilton Corliss engine, rope-connected to a motor generator set. During 1906 and 1907 a similar set was installed, thus giving two 600 kw. Stanley alternators, ordinarily used as motors to drive 400 kw. Bullock direct current generators to which they are direct connected.

Station "K"—Boring.

Building: Corrugated iron; brick wall between boiler room and engine room.

Power Equipment:

Four 100 h.p. Erie tubular boilers with Dutch ovens, 100 lb. pressure.
One 500 h.p. Hamilton Corliss engine, non-condensing, 20 in. x 44 in.; belted to motor generator set.

Electrical Equipment:

Gen. Cap. 400 kw. Trans. Cap. 975 kw., secondary generator 400 kw.
1-400 kw. motor generator set, 10,000 volt, 33-cycle, 400 r.p.m., 550 volt, d.c., rope connected to 500 h.p. engine.
1-400 kw. motor generator set 10,000 volt, 33-cycle, 500 volt d.c., 400 r.p.m.
3-300 kw. transformers, 33,000/29,700-11,000 volts, 3-phase, 33-cycle, water cooled.
1-75 kw., 33-cycle transformer, on 2300 volt feeder.

LATEST of the company's steam plants, except for that bought from the Mt. Hood Railway & Power Company, is Station "L" in East Portland, near the center of the city on the Willamette River, where an ample supply of condensing water is available. The most noteworthy feature of this plant, aside from its up-to-date design, is the foundation, a 3 ft. reinforced concrete slab supported by piles spaced at three ft. centers, many having been driven over 150 ft., and surrounded by a fill of 80,000,000 cu. yds. to equalize the pressure and prevent settling.

Sawdust is used as fuel, being conveyer-fed from a 112 x 54 ft. storage bin which in turn is connected by a double track railway to the mill of the Inman Poulsen Lumber Company. Each boiler is also equipped with a Hammel oil burner for auxiliary firing, either independently or in combination with sawdust firing.

The Curtis turbines are intended for local lighting and transmission, generating alternating current at 11,000 and 2300 volts respectively, the Hamilton engine caring for railway requirements, generating direct current at 625 volts. Space is also provided for a 5000 kw. horizontal turbine.

The switchboard stands on the main operating floor and is suspended by pipe from the high tension switch gallery. The generator leads and the high tension cable are run in fibre or clay ducts imbedded in concrete. The control and lighting wiring is run in metal conduit carried in the station floors. Duplicate sets of bus bars are provided for the 11,000 and 2300 volt machines. Each feeder and machine is connected to both bus bars through two sets of disconnecting switches and remote control motor-operated oil switches. Adjoining the generating station is a reinforced concrete substation with a transforming capacity of 9900 kw. containing three 3300 kw., 3-phase transformers, 33,000/57,100-2300/1100 volts.

Station "L"—Foot of East Clay.

Building: Reinforced concrete, 132 ft. x 160 ft. steel roof trusses, boiler room 58 ft. x 156 ft., engine room 67 ft. x 156 ft., concrete stack 12 ft. in diameter, 125 ft. high.

Power Equipment:

8-440 h.p., 21 x 10 boilers, 175 lb., 2 in a battery, Dutch oven settings fitted with sawdust stokers and oil burners.
One 34 in. and 68 x 54 cross compound Hamilton engine, 90 r.p.m., 3500 h.p.
Two 2000 kw. Curtis turbines, 4-stage, 175 lb. pressure, 1800 r.p.m.
One 120 h.p. single cylinder automatic Skinner engine, 11 in. x 12 in. 275 r.p.m.
One 5000 sq. ft. Alberger counter current surface condenser, horizontal type.
Two 8500 sq. ft. condensers same as above.
Three 10 in. x 16 in x 16 in. Alberger suction valveless hotwell pumps.
One 12 in. motor driven centrifugal circulating water pump.
Two 15 in. pumps same as above.
Three 12 in. x 22 in. x 18 in. Alberger dry vacuum pumps.

Electrical Equipment:

Gen. Cap. 6000 kw. Trans. Cap. 2378 kw. sec. gen. 2000 kw.
One 2000 kw., 3-phase, 60-cycle generator, 10,000 volt, revolving field type, horizontal shaft, 1800 r.p.m.
One 2000 kw., 3-phase, 60-cycle generator, 2300 volt, revolving field type, horizontal shaft, 1800 r.p.m.
One 2000 kw. d.c. generator, 625 volt. 90 r.p.m., horizontal shaft.
Two 1000 kw. motor generator sets, 10,000 volt, 60-cycle, a.c., 500 volt d. c., 514 r.p.m.
Six 367 kw., single-phase transformers, 10,000/23,000 volt.
Four 75 light mercury arc rectifier sets, oil cooled type, double tube.

MORE power has been recently developed on the Clackamas River, two and a half miles below the Cazadero plant, by the construction of a 9900 kw. plant at River Mill. This installation is notable for the rapidity of its construction, considering the exceedingly substantial manner in which it is built, and for the fact that it employs the first Ambursen type

River Mill Power Plant, Power House and Amburson Dam.

of dam for power plant work on the Pacific Coast. All the available power in the river below the Cazadero plant is here developed under a head of 83 ft.

After seven months of preliminary surveying, actual construction was commenced by the contractors, the Puget Sound Bridge & Dredging Company, on June 1, 1910, their work being completed by November 15, 1911. In the meantime the installation of the hydraulic and electrical equipment was so efficiently directed by the Portland Railway, Light & Power Company that the first unit was delivering power to Portland on November 11, 1911, the second unit two weeks and the third just a month later.

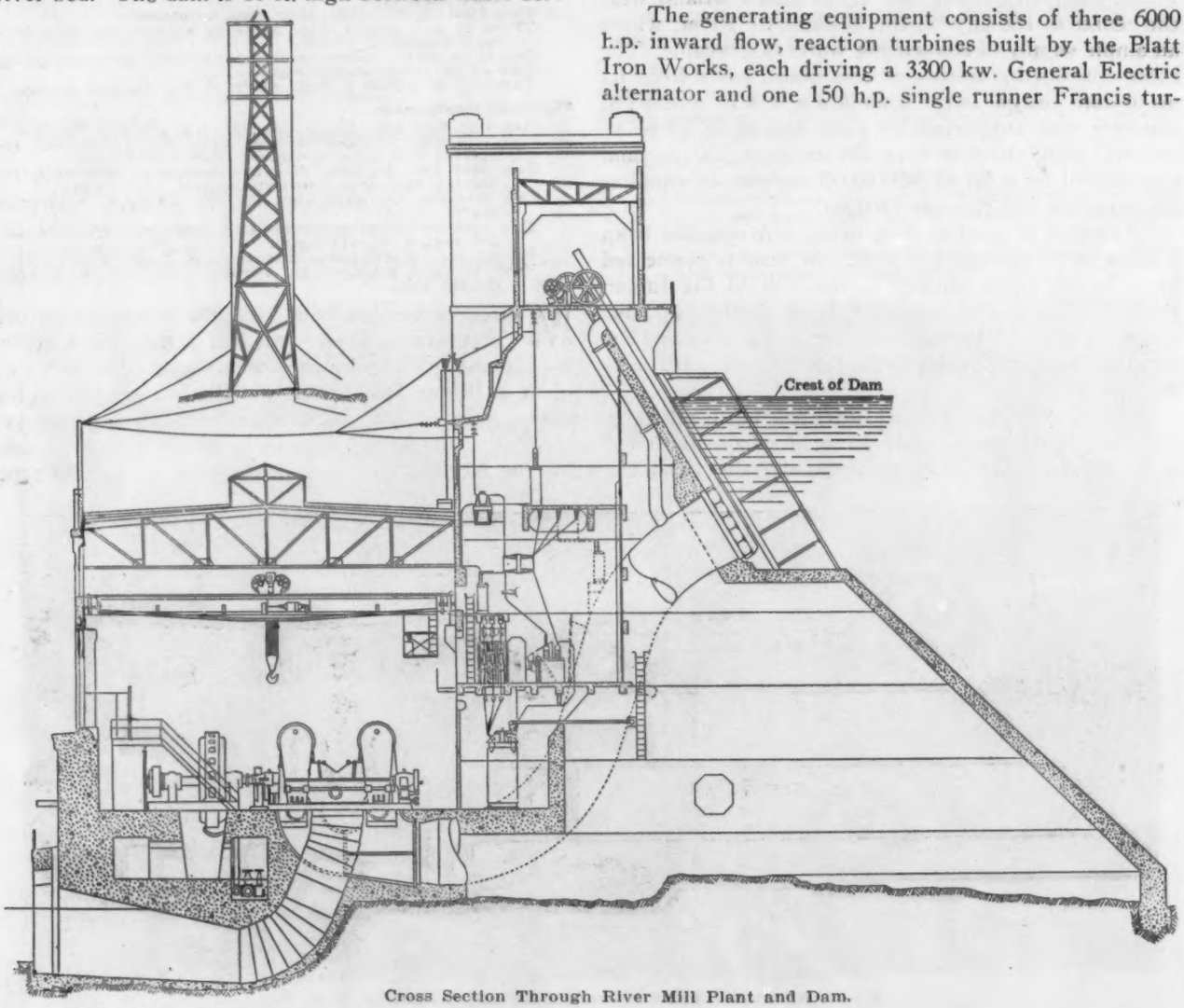
The bed rock is an andesite cut by vertical basalt dykes and so filled with cracks as to require a cement filling or grout, in order to prevent water seepage. Motor operated Davis calyx shot drills were employed to make a regular series of 375 holes through which a mixture of cement was forced to permeate the rock so as to make it water tight.

The Ambursen dam is a hollow structure consisting of a series of parallel concrete walls, or buttresses, supporting and covered with concrete slabs, the base of the down stream side of the spill-way terminating in a curved apron discharging the water parallel to the river bed. The dam is 80 ft. high between water services and 935 ft. long, 407 of which being spill-way. The power house is an integral part of the bulkhead or non-overflow portion on the east bank, the bulkhead buttresses on either side being 15 ft. higher than those of the spill-way. The buttresses are spaced on 18 to 14 ft. centers and taper from 15 in. at the top to a bottom thickness of 48 in. Reinforced concrete beams 18 in. x 12 in. laterally brace the buttresses. The concrete in the buttresses is a 1:3:6 mixture and in the deck and apron a 1:2:4 mixture. Vents to relieve vacuum stresses are provided in the bays between the buttresses, this stress being considerable at times of high water.

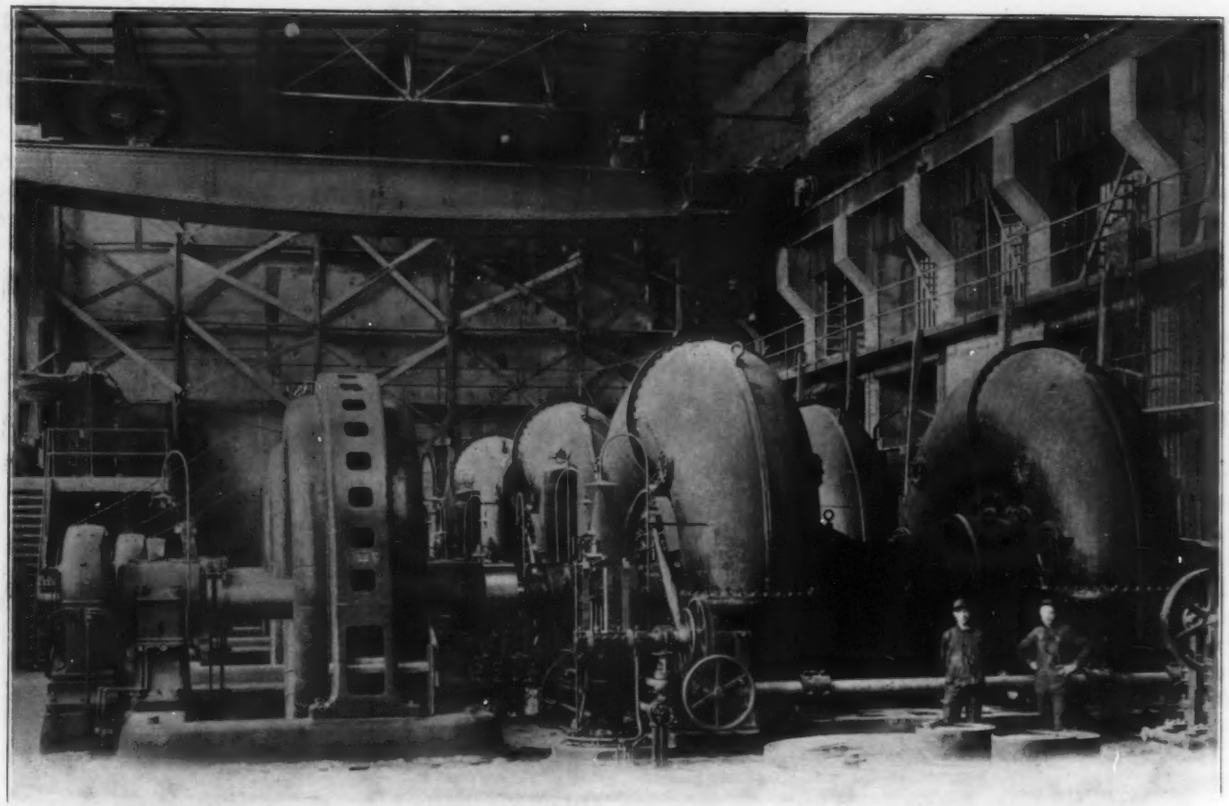
The water may be discharged in three ways: over the spill-way, through the penstocks or through sluice ways under the dam. The last named are hand operated slide gates, designed to discharge 3000 cu. ft. per minute and are used in draining the pond.

Penstocks are 11 ft. in diameter, being made of steel plate varying in thickness from ⅜ in. at the intake to ½ in. at the discharge. The supply gates are arranged for either hand or motor control. The trash racks are 5/16 in. steel straps, 3½ in. deep, spaced 1¼ in. apart and supported by a frame work of channel iron and I-beams anchored in the concrete of the dam.

The generating equipment consists of three 6000 h.p. inward flow, reaction turbines built by the Platt Iron Works, each driving a 3300 kw. General Electric alternator and one 150 h.p. single runner Francis tur-



Cross Section Through River Mill Plant and Dam.



Interior of River Mill Plant.

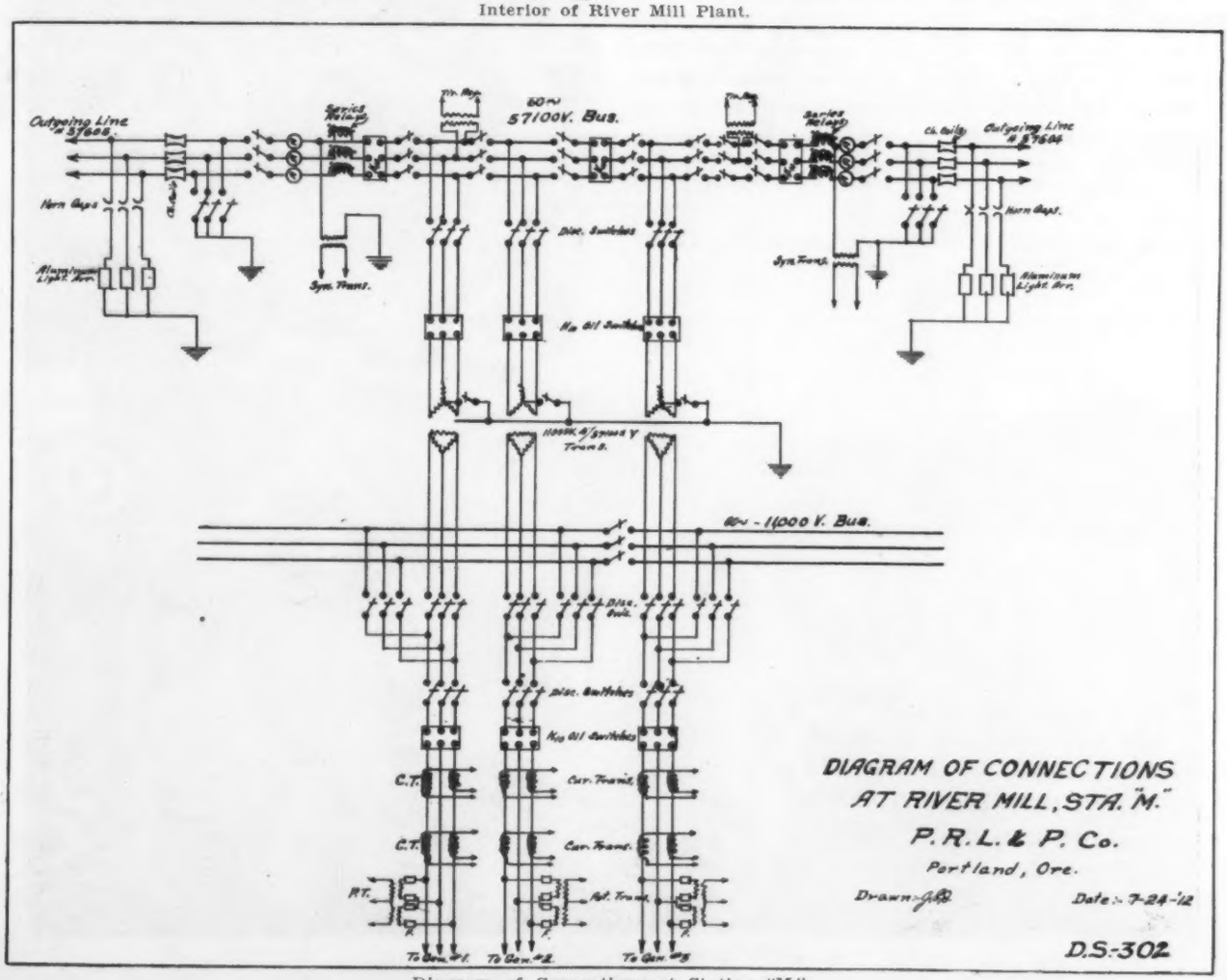


Diagram of Connections at Station "M."

bine operating the exciter under 81 ft. head. In addition to the usual Lombard Type "H" governor, each of the units are operated with an emergency closing device, while the exciter is regulated by a Woodward friction type of governor. The power house has been designed and penstocks, draft tubes, brush racks and sluice gates have been provided for the subsequent installation of two more units.

The switchboard is situated on a gallery at one corner of the plant on the side opposite the oil switches and high tension apparatus. Remote control for the oil switches is provided from the switchboard. The seven panels are of dull slate and equipped with General Electric instruments, there being three machine panels one exciter, one station and two blanks.

The field leads for the generator and the main armature as well as the exciter leads, are carried through 3 in. fibre conduit, supported on racks in the tunnel under the machine, and thence up through the down stream side of the power house to the switchboard. All instrument control and lighting leads are carried in conduits so installed that every conduit drains to a central condulet, thus preventing the conduit filling with water from condensation or other causes.

Station "M"—River Mill.

Building: Concrete, 60 ft. x 173 ft., roof supported by steel trusses.

Dam: Ambursen type, length 935 ft., of which 407 ft. is spillway; height 80 ft.

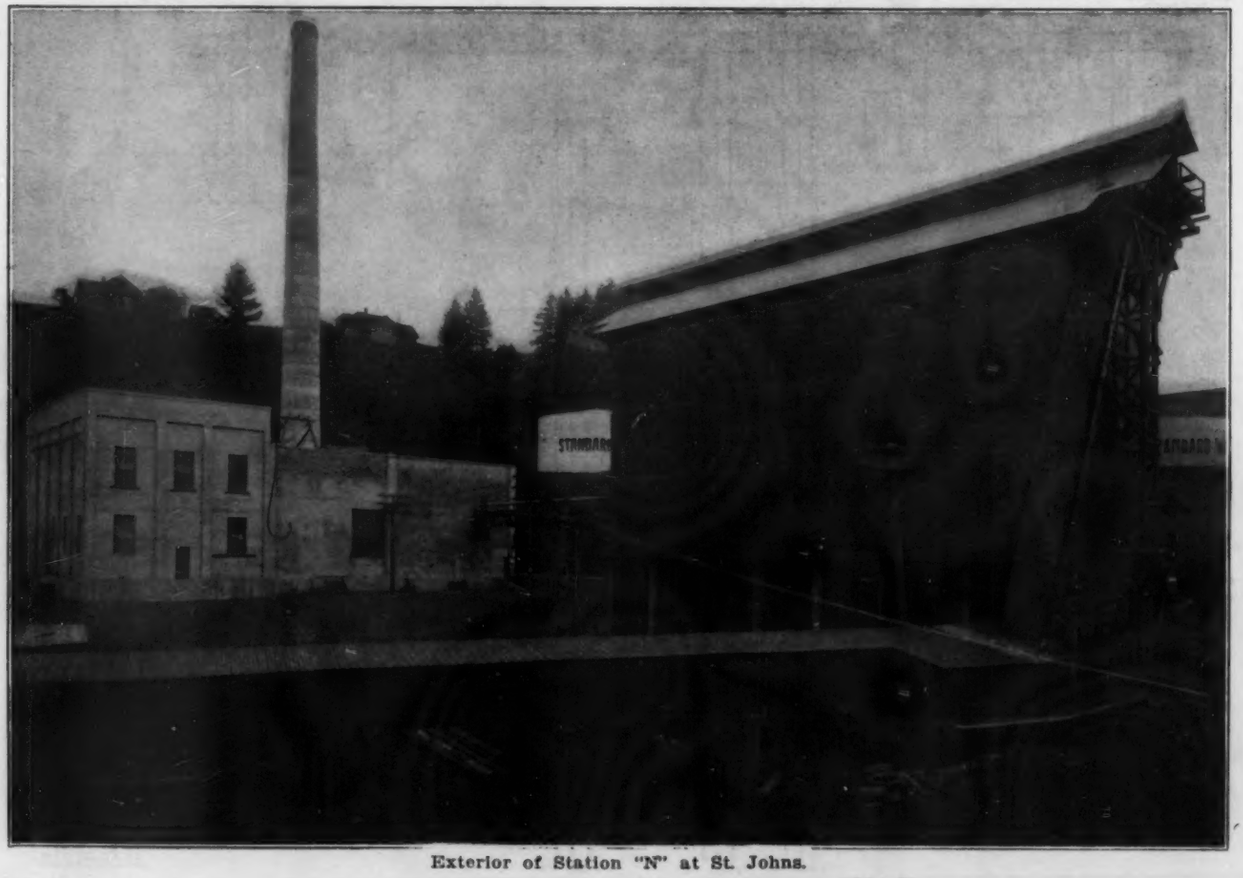
Power Equipment: 3 pair, 6000 h.p. Victor turbines, horizontal shaft, Lombard governors with emergency closing device.

Electrical Equipment:
Gen. Cap., 9900 kw. Trans. Cap. 10,000 kw.
Three 3300 kw., 60-cycle, 3-phase generators, 10,000 volts, revolving field type, horizontal shaft, 240 r.p.m.
Three 3300 kw., 3-phase, 60-cycle, transformers, 33,000/57,100-11,000 volts, Y connected.
One 100 kw., 3-phase, 60-cycle transformers 11000/230 volts.

NEARLY a year ago the Portland Railway, Light & Power Company took over the properties of the Mt. Hood Railway, Light & Power Company, comprising about 40 miles of steam railway, a 2500 kw. steam plant at St. Johns in North Portland, now known as Station "N," and a 10,000 kw. hydroelectric plant at Bull Run, the terminus of the railway. A double circuit aluminum conductor transmission line, extending from Bull Run to St. Johns, was also included in the transfer.

Interior of Station "N."

The steam plant at St. Johns is equipped with a 2500 kw. generator driven by a Parsons steam turbine built by the Allis-Chalmers Company. This plant also is fitted to burn either sawdust or fuel oil.



Exterior of Station "N" at St. Johns.

Station "N"—St. Johns.

Building: Concrete 61 ft. x 72 ft. x 32 ft. high, roof supported by steel trusses, concrete smoke stack, 189 ft. high, 7 ft. inside diameter at top, 12 ft. inside diameter at base.

Power Equipment:

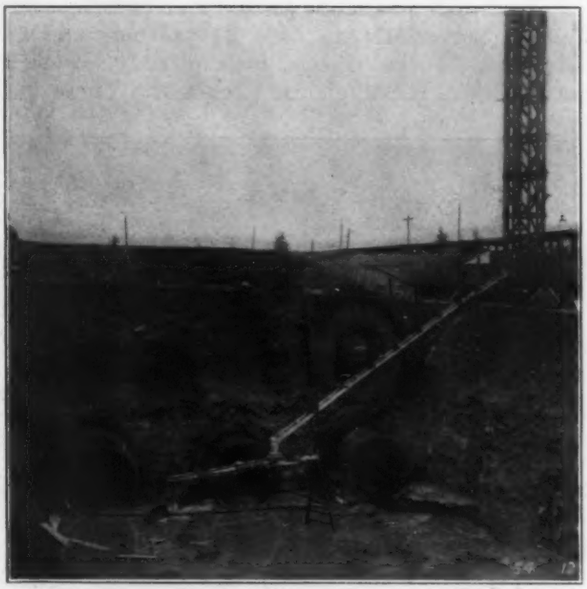
Three 512 h.p. Stirling water tube boilers set with extension furnaces equipped for hog fuel and oil burners.
One 2500 kw. Allis-Chalmers-Parsons type turbine horizontal shaft, 1800 r.p.m.
One 4800 sq. ft. Wheeler condenser.
One Wheeler centrifugal hotwell pump driven by 5 h.p. Kerr steam turbine.
One 9 x 22 x 12 Wheeler rotative dry vacuum pump.
One 16 in. Wheeler centrifugal circulating pump.

Electrical Equipment:

Gen. Cap. 2500 kw.
One 2500 kw. 3 phase, 60-cycle generator, revolving field, horizontal shaft, 1800 r.p.m.

ON the west bank of the Bull Run River, forty miles from Portland is the Bull Run power house, which the Portland Railway, Light & Power Company bought from the Mt. Hood Railway & Light Company in 1912 before it was completed. Work has been prosecuted diligently during the past year and its 11,250 kw. of hydroelectric power will be ready for delivery in Portland before the end of 1913.

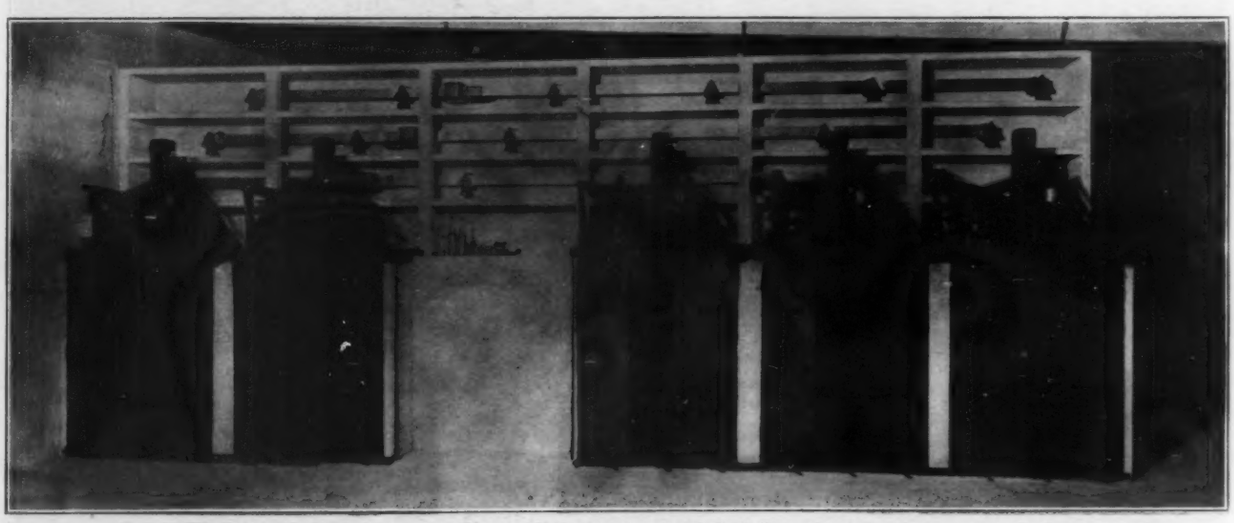
The development has been made possible by a diversion of the water of the Big Sandy and the Little Sandy Rivers to a forebay reservoir, having a capacity of 2103.75 acre ft. A 16 ft. concrete dam has been built to divert the waters of the Little Sandy through 3¼ ft. of timber flume which is also to be supplied with water diverted from the Big Sandy by a 26 ft. dam and carried through three miles of flume and tunnel. The tunnel is 4004 ft. long while the canal provides for several small tunnels 100 ft. or more in length.



Mt. Hood Intake. Showing Three Penstocks and Temporary False Work During Construction.

Mt. Hood Timber Flume.

The forebay intake is of concrete construction in which are installed three 10 ft. balanced butterfly valves, motor operated by remote control from the power house. The penstocks run from the forebay through two tunnels respectively 453 and 250 ft. long, each of the 9 ft. steel pipes branching into 6 ft. penstocks at the end of the second tunnel. Surges are to be cared for by 5 ft. standpipes 42 ft. high, connected through an expansion joint to tanks 15 ft. in diameter and 15 ft. high, the elevation of the surge tanks being about 8 ft. above the water surface and the forebay pond. In the 1500 ft. of penstock length there is a drop of 320 ft.



Oil Switches at Station "O," Bull Run.

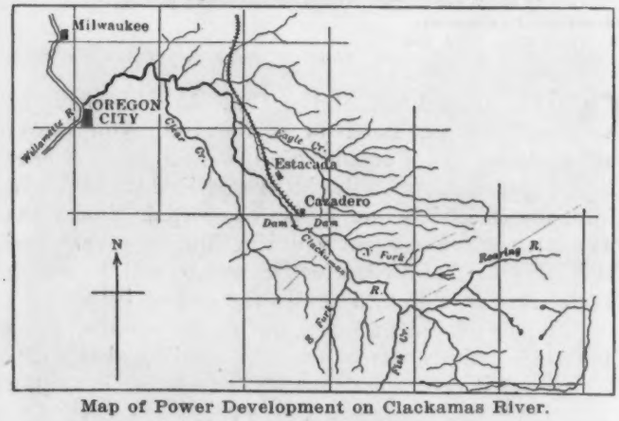
The initial installation at Bull Run consists of one Wellman-Seaver-Morgan 6400 h.p. turbine and two Platt Iron Works wheels, each directly connected to a 3750 kw. Westinghouse generator. These units

Interior of Mt. Hood Plant, Station "O."

are set diagonally, i.e., their axes are at an angle to the power house, for the purpose of avoiding bends in the penstock and to economize space. Water admission is controlled by 54 in. hydraulic lift gate valves with 8 in. by-pass and Lombard governors.

The switchboard stands on a gallery 16 ft. above the operating floor and in front of the oil switches, all the instruments being of Westinghouse make. The exciters are under the switchboard gallery, each consisting of 300 h.p. Victor turbine, with Woodward governor, driving a 150 kw. Westinghouse generator.

The plans call for concealed conduits to carry all wiring. The bus-bar barriers, the switch cells and the transformer comparaments are all of concrete.



Map of Power Development on Clackamas River.

Station "O"—Bull Run.

Buildings: All concrete with roof supported by steel trusses. General building 191 ft. 4 in. x 47 ft. 4 in. x 66 ft. high; 6600 volt switching room 58 x 55 x 54 ft. high; transformer house, 54 x 36 x 24 ft. high.

Power Equipment:

Two h.p. 42 in. Victor turbines, horizontal shaft, Lombard governors (Platt Iron Works).

One 6400 h.p. Victor turbine, horizontal shaft, Lombard governor (Wellman-Seaver-Morgan).

Electrical Equipment:

Gen. Cap. 11,250 kw. Trans. Cap. 21,000 kw.

Three 3750 kw., 3-phase, 60-cycle generators, 6600 volt, 514 r.p.m. revolving field type, horizontal shaft.

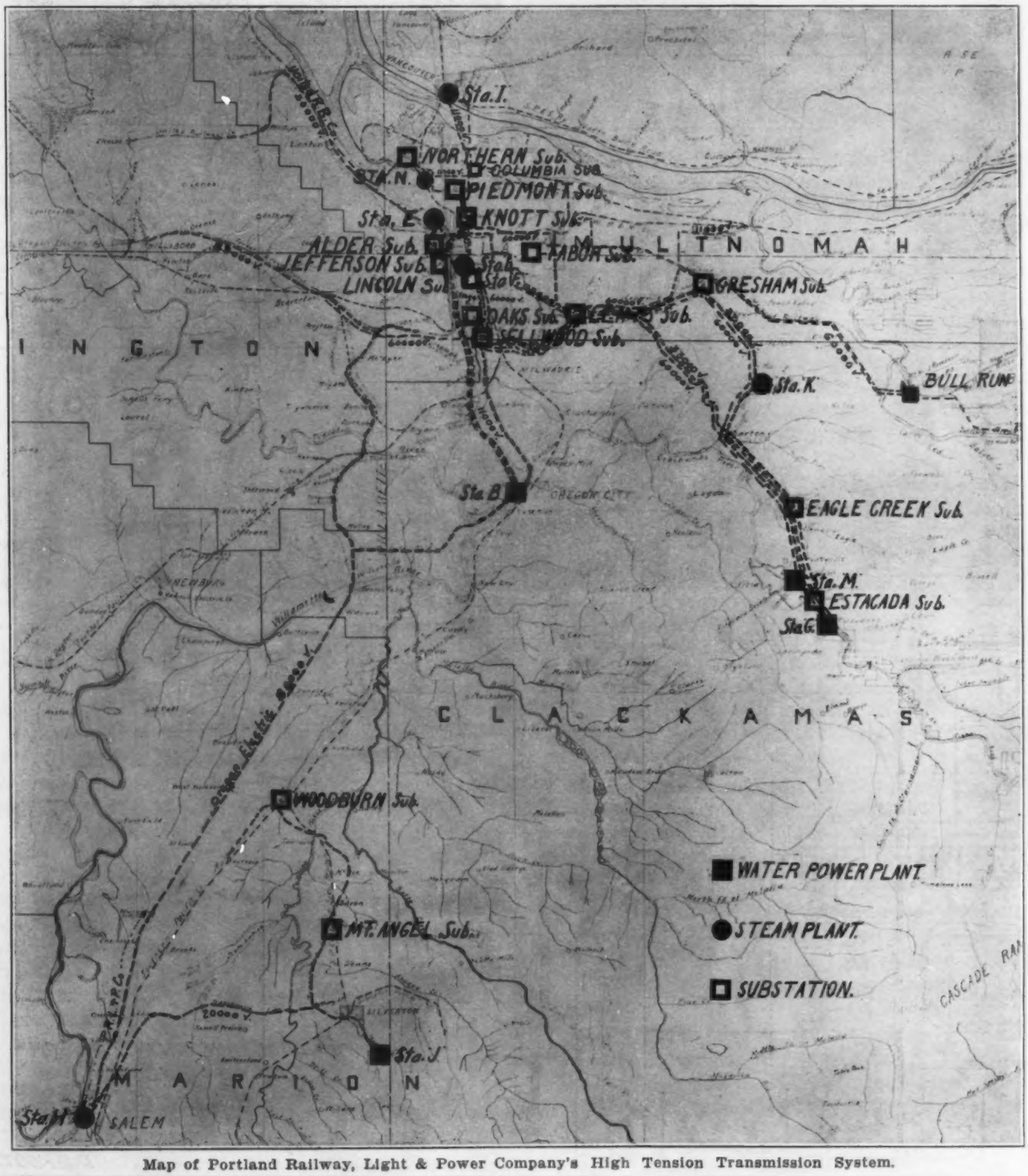
Seven 3000 kw., 1-phase, 60-cycle transformers, 33,000-18,200-volt.

Exterior of Mt. Hood Plant, Station "O."

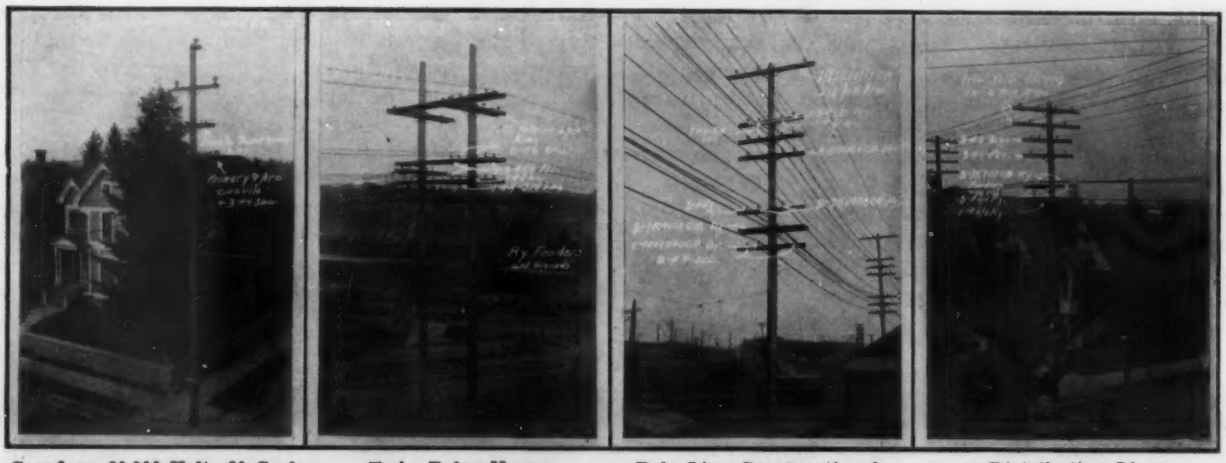
THE transmission system is one of the most important factors in maintaining the exacting requirements of urban and interurban railway, light and power service from the distant water power plants upon which this company places its chief reliance. There are in all 280 miles of high tension line, the operating potentials being 57,000, 33,000 or 11,000 volts.

The 57,000 volt lines include the 40-mile pole transmission from Oregon City to Salem, the 27.6-mile steel tower line from the River Mill plant to Lincoln substation, 30.76 mile pole line from Station "G" to Knott sub., and 27.1-mile double pole line from Bull Run to St. Johns. The first named is the property of the Oregon Electric Railway; the second was recently constructed upon the completion of the River Mill plant, and the last was acquired from the Mt. Hood Railway & Power Company.

The line from River Mill to Lincoln substation has 310 towers with the standard spacing of 500 ft. Each tower is constructed of galvanized angles, channels, etc., bolted together, giving a self supporting or inflexible type, designed to carry two power circuits of three conductors each, one 2-wire telephone circuit and one ground circuit. The insulators are made up



Map of Portland Railway, Light & Power Company's High Tension Transmission System.

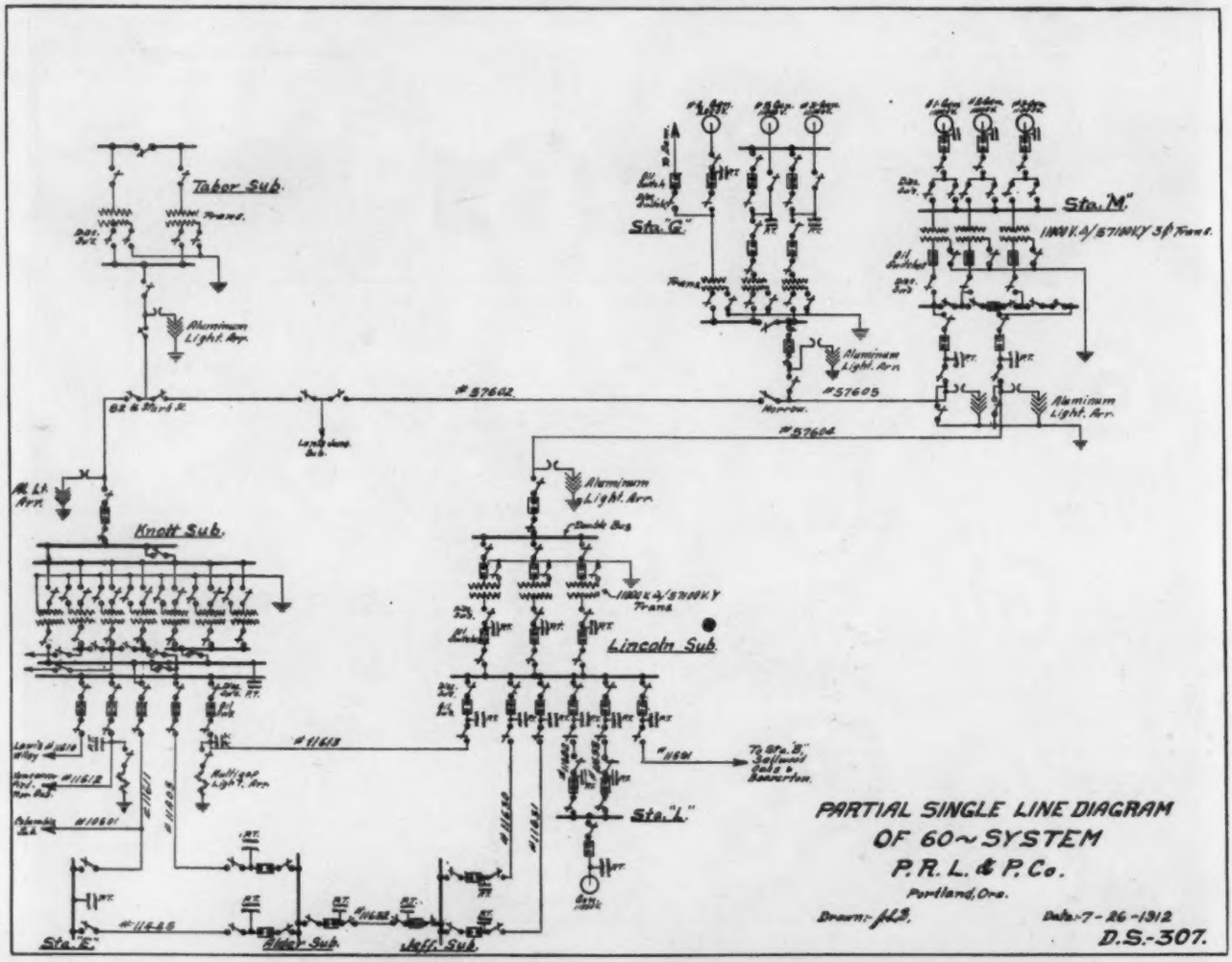


Cazadero 60,000-Volt, 60-Cycle Transmission Line. | Twin Poles Near Station "L" | Pole Line Construction In Portland. | Distributing Lines.

of three single-phase unit, suspension type. The conductor has 250,000 c.m. hard drawn stranded copper. The double pole line from Bull Run to St. Johns is to be operated at 57,100 volts, the conductor being stranded aluminum equivalent to No. 000 copper.

The double 31 mile pole transmission from Cazadero to Portland is operated at 33,000 volts while the lines from Oregon City to Portland are a 11,000 volt transmission.

SUBSTATIONS of this system may be considered under three sub-divisions: interurban railway, those around Salem and those supplying Portland. The substations along the line of the Cazadero branch of the Oregon Water Power road comprise those at Estacada, Eagle Creek, Gresham, Boring and Lents. The first is solely a transformer substation, stepping down from 33,000 to 2300 volts for local lighting through a 25 kw. transformer. The others are equip-



Partial Single Line Diagram of 60-Cycle System.

ped with 33 cycle rotary converters, furnishing direct current for railway use, Eagle Creek and Gresham each having one 400 kw. machine, and Lents one 1000 kw. and two 400 rotary converters. The equipment at Boring has already been noted under Station "K."

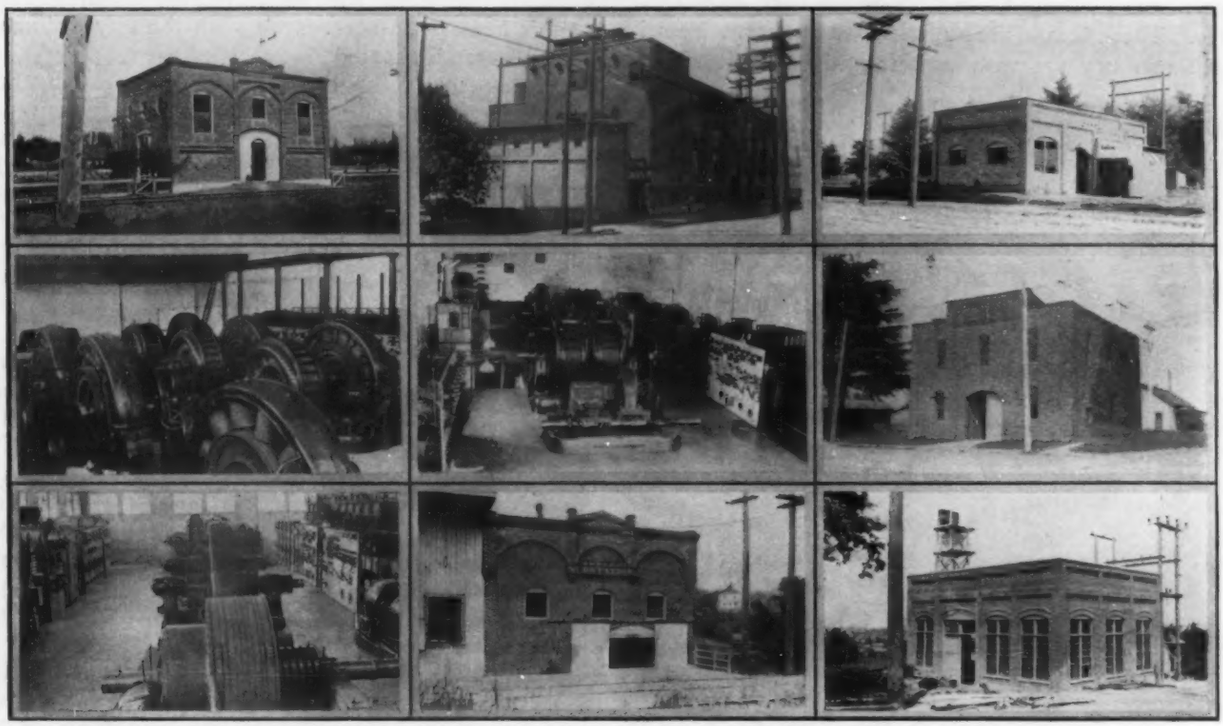
Each station is housed in a brick building with concrete foundation. The Oregon City branch of the O. W. P. is supplied with direct current at 600 volts from a 1000 kw. coverter set in the Sellwood substation, which also furnishes current for local incandescent and arc lighting.

The Oaks, on the railway line, is a 400 kw. transforming station, supplying 110 and 220 volt current tc a park of that name on the banks of the Willamette. In addition to the transforming equipment and station at Salem, transformer stations at Woodburn and Mt. Angel supply the current to these towns.

The substations in Portland and suburbs transforming current for lighting purpose and converting for railway and power service, are the Alder street and Jefferson street in West Portland and the Lincoln, Tabor, Knott, Columbia, and Northern as well as St. Johns on the east side of the Willamette. The several substations on the east side of the river are tied together with a 10,000 volt, 33-cycle cable looped into each station in such a way that the energy may be derived from two directions, thus allowing any section to be cut out at any time for repairs. The Alder street substation is situated in the basement of the Flectric Building at Seventh and Alder streets, and is the main distributing point for the system.

Direct current for 600 volt railway service is supplied by two 1000 kw. rotary converters. Seven 1000 kw. motor generator sets give direct current at 250 volts for power use, and one 500 kw. motor generator supplies direct current at 500 volts for commercial service. This station has a total transformer capacity of 2387 kw. and secondary generating capacity of 10,255 kw. The storage battery set of 132 cells is capable of supplying 30,000 amperes for 10 minutes.

The Jefferson sub. has a transformer capacity of 2742 kw. and secondary generating capacity of 5405 kw., direct current being supplied at 600 volts for railway service by means of motor generator sets.



Substations of Portland Railway, Light and Power Company.

Eagle Creek.	Knott.	Northern.
Alder.	Knott Interior.	Sellwood.
Jefferson.	Gresham.	Tabor.

The Knott is the largest of the East Portland substations, supplying 4000 kw. of direct current for railway service and 15,028 kw. transforming capacity.

The Lincoln sub. is the Portland terminal of the steel tower line from the River Mill plant and steps down from 57,000 volts through individual 3-phase 3300 kw. transformers star connected to 11,000 volts.

The Tabor sub. has a transforming capacity of 2764 kw. and secondary generating capacity of 1000 kw.

The Columbia sub. has a transforming capacity of 8276 kw.

Northern sub. has a secondary generating capacity of 800 kw. and transforming capacity of 2532 kw. The St. Johns sub. at Station "N" has a transforming capacity of 1500 kw., containing two 750, 3-phase, 60-cycle transformers.

There is also a substation at Vancouver, Wash, having a transforming capacityy of 1188 kw.

Distribution and General Utilization.

Electric power is distributed through the city of Portland and suburbs at a potential of 2400 volts. The city has been divided into districts with a separate feeder to selected centers of distribution in each district. The potential is stepped down to 240 volts for a three-wire distribution by means of transformers carefully placed throughout the district and the secondary system as far as possible is tied together.

The Portland streets are illuminated by 3103 magnetite arc lamps of which 171 are multiple, and the balance series, there also being 1169 commercial arcs. These lamps are supplied with current from 75 light mercury arc rectifier sets and constant current transformers which are operated directly from 10,000 volt, 33-cycle, and 60 volt, 3-phase generating system.

The incandescent lighting load totals 757,751, 16 c.p. equivalents, on a.c. and d.c., 220/110 volt circuits, while the motor load totals 39,216.07 h.p., 220 volt a.c. and 500 volt d.c.

Street Railways.

Portland's first electric railway was built in 1894, when Station "B" was equipped to furnish current for its operation. Within the next few years, other companies entered the traction field until in 1901 there were four independent concerns operating about one hundred small cars to carry about 50,000 passengers daily. Two of these companies were later consolidated and in 1906 all were absorbed by the Portland Railway, Light & Power Company, which now operates over five hundred cars over 200 miles of track to carry as high as 300,000 passengers daily. In addition there are 76 miles of interurban railway. For the following details on the railway system, the author is indebted to H. M. Clark of the company's railway department.

The railway system of the Portland Railway, Light & Power Company covers 272 miles of equivalent single track, 143 miles of which is standard gauge (4 ft. 8½ in.) and 129 miles narrow gauge (3 ft. 6 in). This is exclusive of yard and carbarn track. This trackage represents the consolidation of the narrow gauge city and suburban lines in and around Portland (formerly the Portland Railway Company) with the standard gauge suburban and interurban lines of the Oregon Water Power Company in which is now included the recently acquired interurban line to Bull Run, formerly the Mount Hood Railway & Power Company. The general operating divisions are two in number, viz: city system and interurban system.

City System.

The city division embraces thirty-three lines with a total of 196 miles of track—6 lines are standard gauge, the balance being 3 ft. 6 in. Half of the total closed city equipment in Portland is pay-as-you-enter type which has been adopted as standard. The other principal types are a three compartment, double truck, closed car of local design and construction and a 45 ft. double truck American Car Company car of ordinary type.

The pay-as-you-enter car was first introduced in Portland in 1909 and since that time all cars purchased have been of this type. There is some little difference in the dimensions of the narrow and standard gauge cars but the general design is the same, both being made by the American Car Company.

The three compartment closed narrow gauge car for city service is of local design and construction, the company having quite a number in use. The other type of closed city car is manufactured by the American Car Company.

City ordinance requires that all cars 35 ft. in length and over be equipped with air brakes. All cars are equipped with Consolidated Heating Company's heaters, in accordance with the city ordinance that all cars be heated.

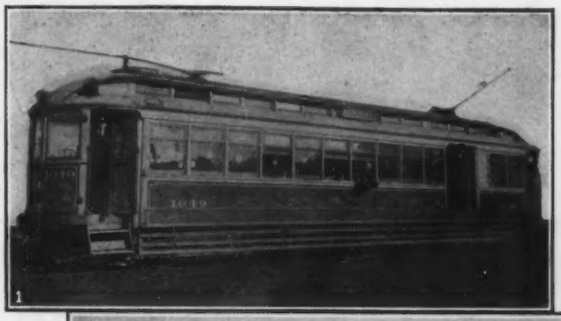
Included in the lines of the city system there is an interurban line from Portland to Vancouver, a distance of 14½ miles. This line is 3 ft. 6 in. gauge and the type of car is different from any others on the system. The cars are operated in trains of two consisting of a four motor car pulling a trailer. This line terminates at the Oregon shore of the Columbia River where passengers are transferred to a ferry boat owned and operated by the company and carried across the Columbia to Vancouver, Washington.

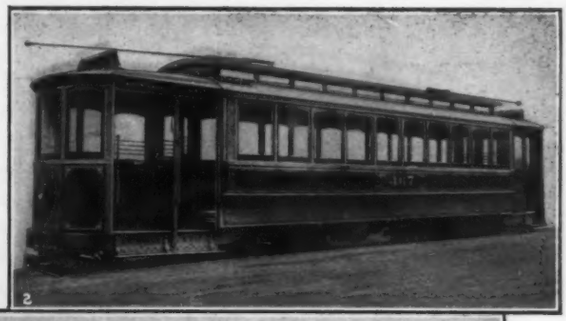
There are two lines on which magnetic brake equipment is used, viz: the Portland Heights and Council Crest line and the Kings Heights line; the latter is of comparatively recent construction. The Council Crest line is noted for its scenic features and attracts much tourist travel in season. In the course of the trip to Council Crest the route climbs the heights to the south and west of the city on an average grade of 5.5 per cent, the maximum grade being 12 per cent. From Council Crest, the highest point in the range of hills surrounding the city, elevation 1200 ft., is a magnificent view of the surrounding country. With the aid of glasses in the observatory of the amusement park there, the glacial formations on the snow capped mountains of Mount Hood in Oregon, and St. Helens, Mt. Adams and Ranier in Washington may be studied. The cars in this service are of semi-convertible type, Brill design and construction. They are 40 ft. in length and have a seating capacity of 40.

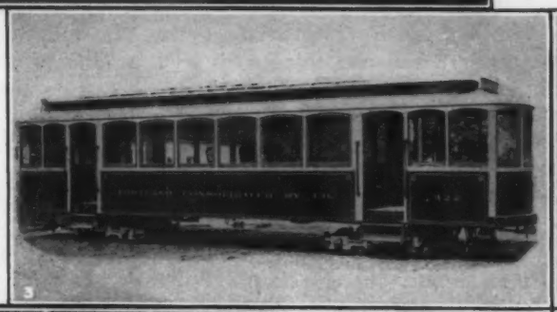
Interurban System.

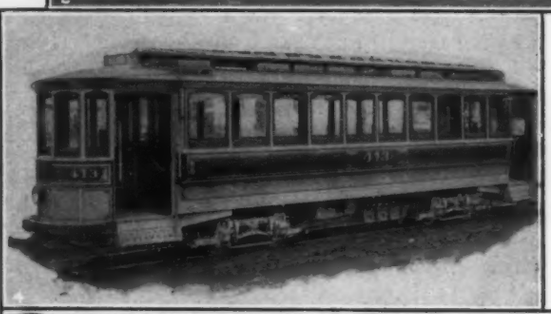
The interurban system covers 76 miles of standard gauge track, over which both freight and passenger service is operated. The longest line is between Portland and Cazadero, a distance of 37½ miles; other lines are: between Portland and Oregon City, a distance of 15 miles; between Montavilla and Bull Run, a distance of 21 miles; between Linneman (a station 10 miles out of Portland on the Cazadero line) and Troutdale, a distance of 7 miles.

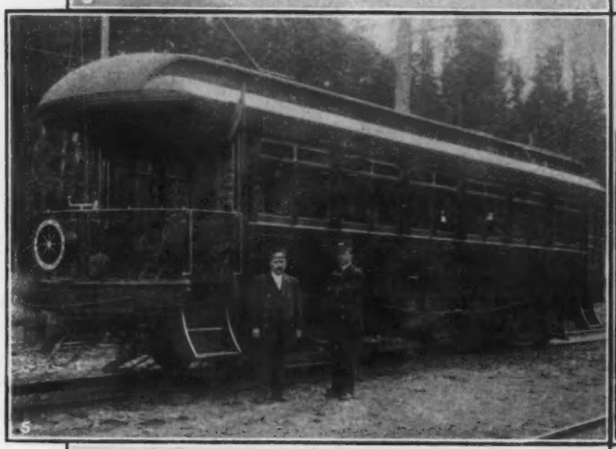
The territory immediately adjacent to the Cazadero line is fast developing into a rich agricultural country, while the country in the vicinity of this line has long been in a high state of cultivation. From a point 17 miles distant from Portland, hourly service is maintained, while beyond that two-hour service is rendered. The trains operated range from 2 to 5 cars in general practice, and excursion business has been taken care of in trains as large as 10 cars. This

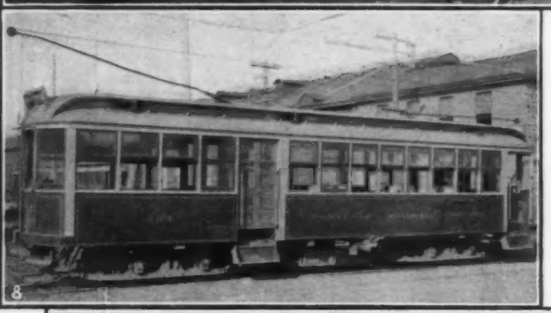








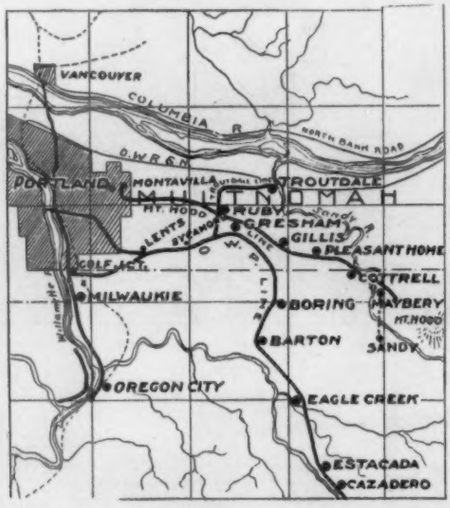




1. One Type of Interurban Car.
2. Type of P. A. Y. E. Car, City System.
3. Three-Compartment Car, City System.
4. Type of Closed Car, City System.
5. Officials' Car on Interurban System.
6. Freight Locomotive Built in Company's Shop.
7. Express and Baggage Car on Interurban System.
8. Car Used on Vancouver Line, City System.
9. Interurban Train—Cazadero Line.
10. Special for Trainmen's Picnic.

line is the source of a heavy carload freight business —cordwood predominating. Brick, fir logs, gravel, crushed rock and other commodities are also handled as well as large shipments of merchandise. The majority of all wood shipments into the city of Portland are brought in over this track.

Between Linneman Junction and Troutdale, a branch of this line is operated, touching at Fairview where this company has physical connection with the O. W. R. and N. While at this time the passenger and freight business is not excessive, it is expected that in the near future more business will arise, particularly as the freight business from the Mount Hood line will be operated over a portion of this track. A certain amount of wood used in the manufacture of paper is also shipped from Troutdale, which supply is drawn from the banks of the Columbia River. Outside of five miles of double track between Portland and Golf Junction, a distance of 5.36 miles, single track operation prevails. Sidings are situated at such places as will properly take care of the operation. Between Golf Junction and Lents Junction, a distance of 5½ miles, the track is protected by block signals. Beyond that point block signals have not been installed.



Map of Clackamas Drainage.

The line between Portland and Oregon City runs for a part of the way through beautiful residence districts, taking in several small and beautifully situated towns, and through quite a rich farming country. The holdings of the farmers are comparatively small on account of the high land values. Oregon City, while not the terminus of the line, is the main point from which trains are operated, and has a population of about 5000. Beyond the falls at Oregon City, is a small residence section known as Canemah, the residents being principally employed in the paper and woolen mills in Oregon City. This company owns the park known as "Canemah Park," situated between Canemah and Oregon City at an elevation of 100 ft. The districts bordering along the line are heavily settled, and passenger business is extremely heavy for an interurban line. Thirty-minute service is maintained throughout the day, and is augmented by trip-per service running a distance of 7 miles to the town of Milwaukie, during the rush hours.

The line between Montavilla and Bull Run, known as the Mount Hood Division, was originally intended to reach a point in the vicinity of Mount Hood. It was taken over by this company with the Mount Hood Railway & Power Company in the spring of the present year. At this time the line is being operated by steam locomotives—three in number, but it is expected that electrification will take place in the near future. The line handles both passenger and freight business.

The entire interurban system is operated under standard railroad rules with such modifications as are necessary to meet local conditions. Agents are located at various points on the line, each covering a certain territory, ranging from about 8 to 10 miles of track.

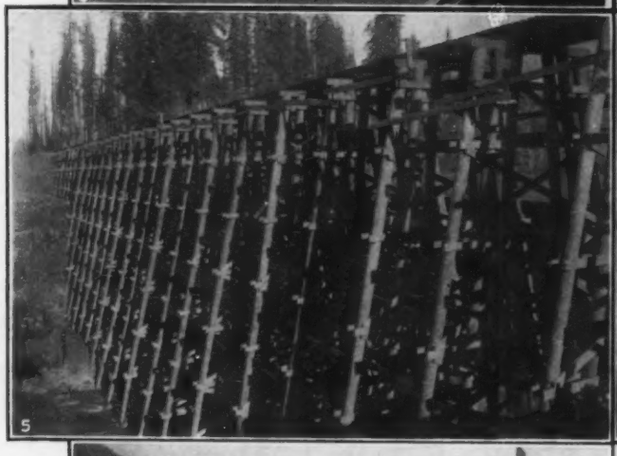
The yards, which are the terminals for freight train operation are situated at East Portland where from 100 to 200 cars are handled daily. At this point also the company has physical connection with the Southern Pacific Railway Company, where carload business is interchanged. The freight service is taken care of by three freight trains daily, and in addition a yard crew takes care of the switching and serves industry tracks. The trains run as high as 40 cars.

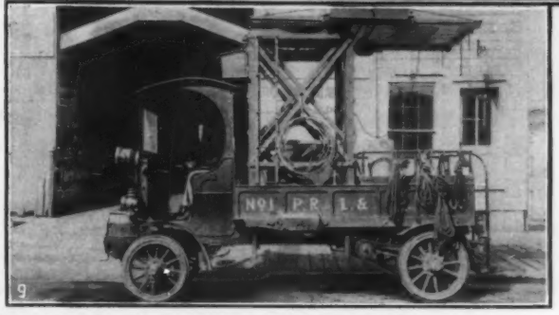
Train dispatching is handled by telephone. Recently the selective ringing type of the Western Electric Company has been installed on both the Mount Hood and Cazadero lines, and will in all probability be extended to cover the Oregon City line. The selective system of ringing is much quicker and more accurate than the old code system of ringing by hand and possesses the added advantage of ringing only the station desired rather than all the stations along the line. Stations can be called at great speed inasmuch as the mechanism operates at the rate of 10 impulses per second making it possible to call station No. 1 in 1/10 of a second, Station No 5 in ½ of a second, etc. The selector key in its operation not only selects the particular station wanted but also automatically rings the bell from two to three seconds. This ringing can be prolonged by the dispatcher through the operation of the strap key which is a part of the circuit. The dispatcher receives an audible signal through his receiver while the bell is ringing at the station called.

The company has eight four-motor locomotives for freight service on interurban lines. They are of the sloping cab type and are all equipped with multiple unit control, which is very desirable for this service in that the motive power may be increased to meet the demands of heavier trains, by merely coupling two locomotives to run as a unit, controlled by one motorman.

Shops.

The company has recently completed erection of buildings for the consolidation of all its car shops at one point, thus obtaining far greater efficiency than was possible formerly with several shops widely separated. The combined shops combine the latest thought in construction and shop operation—the facilities provide for any work from the most minor repair to the construction and equipping of the modern city car or interurban car or locomotive.





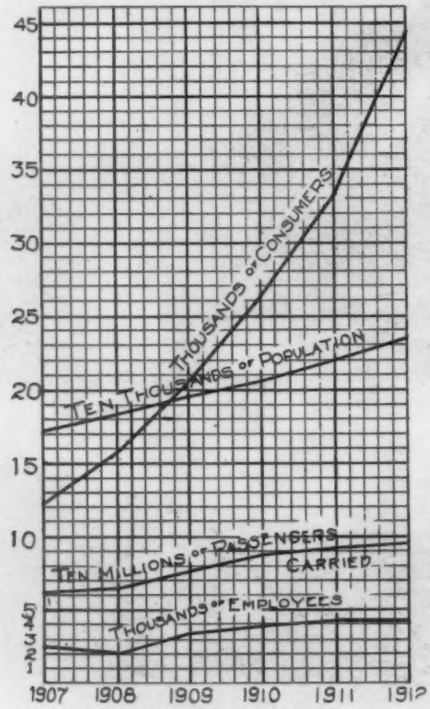
1. Club Rooms in Piedmont Car Barns.
2. Pool and Billiard Room for Employees.
3. Freight House and Dock on Willamette River.
4. Freight House at East Portland Terminal.
5. Trestle on O. W. P. Line at Eagle Creek.
6. Cazadero Track Near Boring.
7. Construction Train at Gravel Pit.
8. Ballast Train With Freight Locomotive.
9. Emergency Line Truck.
10. New Concrete Warehouse at East Portland.

Exterior of New Center Street Shops.

The shop consists of a group of four buildings of brick and concrete construction, one of which is used as a storeroom for all supplies necessary for the road. The machine shop, blacksmith shop, armature room, air room and motor and truck repair shop are housed under one roof.

Conclusion.

This is the story of an undertaking to which no conclusion is in sight. The Portland Railway, Light & Power system is growing faster than Portland

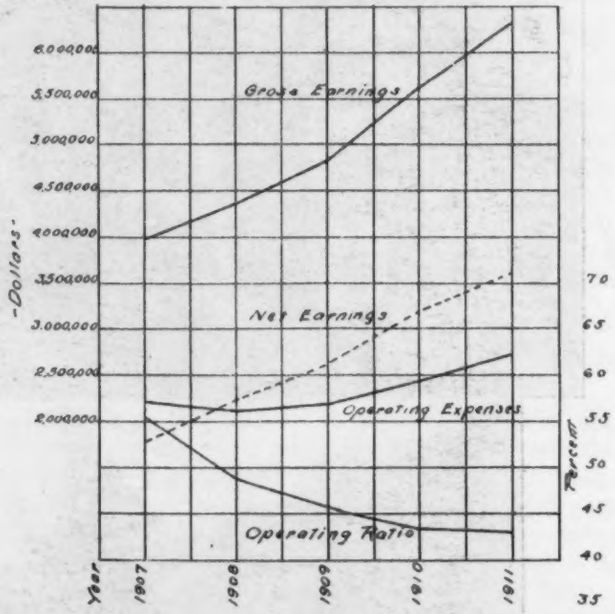


Graphic Illustration of Company's Growth as Compared to Increase in Population.

itself, a city whose population more than doubled between the census of 1900 and 1910. A better showing was made by only four other cities in the hundred thousand class. Portland, as one of the leading wheat and timber ports of the United States, has a well-earned reputation for conservation and has proven an attractive field for investment. Its postal receipts have averaged over one million dollars for the past three years, its building permits over eighteen millions and its bank clearings over five hundred and fifty millions annually.

Meanwhile, since 1900 the number of light and power consumers has increased more than one hundred fold. Although the company has expended nearly twenty million dollars for betterments and additions to property during the past four years, the present demand is so close to the available supply that new hydroelectric development will soon be necessary on the upper Clackamas River.

This phenomenal growth is in a large measure due to the progressive policy pursued by the company. The aggressiveness of business getting is surpassed only by the energy of business holding. Every endeavor



Company's Financial Showing.

has been made to please the public by the best service and lowest rates as well as by the fairest treatment. A most careful study is made of the welfare of each employe and this is reflected in the coutesy exhibited by every representative of the company.

Truly has it been said that an institution is but the lengthened shadow of a man. In the Portland Railway, Light & Power Company that man is its president, Mr. B. S. Josselyn, beloved and respected by every citizen of Portland. During the five years and more which he has represented the interests of E. W. Clark & Company at Portland, his life has been one of service, an inspiring example to every official and employe of the company. He is the fountain-spring of the fine spirit of co-operation and sympathy for which his company is famed and he is responsible for the magnificent financial condition which has been developed under his administration.

W. D. Josselyn

"Josselyn Hall," Mt. Tabor.

ELECTRICAL PUMPING AND IRRIGATION

RETAINING WALLS FOR CANALS.

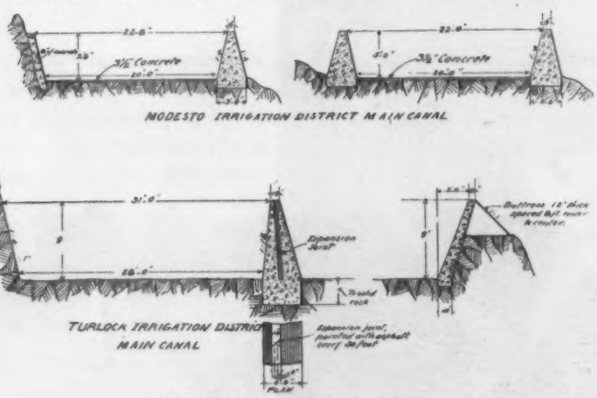
BY B. A. ETCHEVERRY.

Concrete retaining walls may be used to advantage for the following classes of canal construction:

First—Where the slope of the ground is too steep to allow the construction of a canal in cut, as on a sidehill.

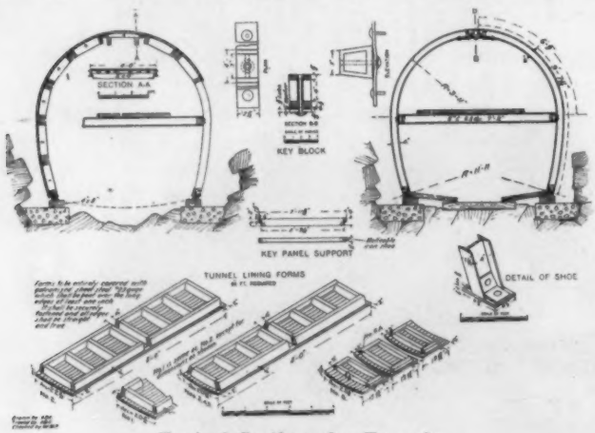
Second—Where the side slopes of the cross section are steeper than the ground will stand and must be retained with a wall.

Third—Where a canal in embankment is not desirable.



Typical Retaining Wall Cross-Section on Modesto and Turlock Irrigation Canals.

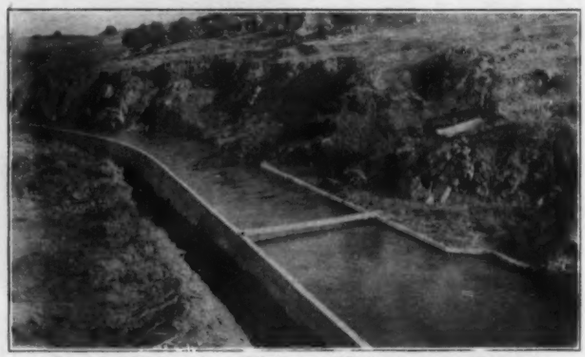
The Modesto and Turlock irrigation systems have several thousand feet of concrete walling on the upper part of their diversion lines near the headworks, where the canals skirt the hillsides. Because of the steep slopes of the hillsides, the canal could not be made entirely in cut and a great portion had to be built originally with an embankment on the lower side, and where too steep for the embankment a wooden bench flume was constructed. The embankment was a source of expense and required careful watching to avoid



Typical Sections for Tunnels.

breaks. The flumes decayed rapidly and their cost of maintenance was high. For these reasons, concrete walling has been used to replace the bench flumes and to retain the earth on the embankment side of the canal. The walls extend below the bed of the canal down to solid foundation and where seepage is liable to occur and undermine the wall a bottom lining of concrete is used. On the uphill side where the rock is fissured or where the material will not stand the erosive action of the water, a sloping concrete retaining wall is built. Where the wall has no backing it is designed as the lower wall to resist water pressure.

A few typical sections of the Modesto main canal and the Turlock main canal are given. The Modesto sections have a floor lining of 2½ inches thick of concrete because of the pervious bed. Part of the Turlock walling consists of an inclined retaining wall supported with buttresses 12 inches thick, spaced 10 feet apart, and extending down to solid foundation. Another section of the walling consists of a retaining wall with expansion joints every 25 feet. These joints were made by placing a temporary dam with a V-shaped tongue between the wooden forms. When the concrete had hardened sufficiently the V-shaped dam was removed and the joint painted with an asphalt mixture before the next section was started. At the apex of the V an iron rod was placed. This rod was removed when the next section was finished and the



Concrete Retaining Wall on Modesto and Turlock Canals.

hole filled with hot asphalt. On the Modesto side, although no expansion joints have been provided, no serious cracks have appeared.

Tunnels.

A tunnel may be necessary:

First—Where it is more economical to run through a ridge than to go around it.

Second—Where the perpendicular cliffs or steep hillsides of a canyon make the construction of an open canal or flume impossible or not economical.

Size of Tunnel.

To make the cross section of a tunnel as small as possible and where the available fall will permit it, the velocity given to the water must be as high as the material will stand without erosion. Where the tunnel is part of a hydroelectric system the decreased cost of a small tunnel on a steep grade must be properly balanced with the value of the loss of power produced by steep grade.

Form of Section.

The best form of cross section is one which is convenient to construct and economical in volume of excavation and in cost of lining where canal is

to be lined. In some material it is not possible to blast a regular section, but where the material can be excavated or blasted to a definite form or where the canal is to be lined with concrete the form may be circular, oval, horseshoe or rectangular. The circular form gives the smallest perimeter for a given cross section; next to this is the oval form, then the horseshoe and the rectangular forms. The horseshoe and rectangular sections are more easily constructed and are frequently employed.

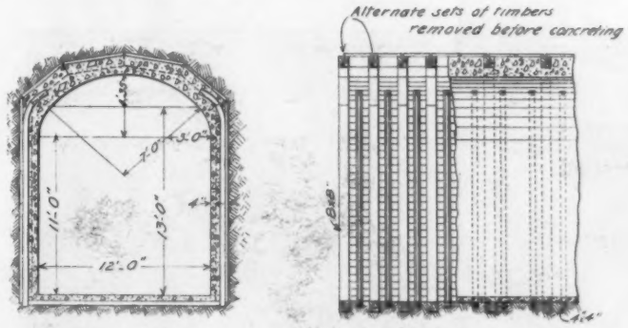
Lining of Tunnels.

The lining of a tunnel may be necessary:

First—To prevent seepage if the tunnel runs through porous material or fissured rock.

Second—To allow a smaller cross section by increasing the carrying capacity.

Third—Where the material will not stand and it is necessary to hold the material up.



Details for Tunnel Lining Forms.

A safe velocity is 10 ft. per second and where the water is free from silt or sand a higher velocity may be used.

For circular tunnels cement pipe has been used in southern California. The ordinary cement pipe is laid on grade, the joints made with mortar, and the pipe carefully backfilled. On the Tieton project large size pipes 8 ft. in diameter and 2 ft. long are used to line the tunnels, the sections are hauled by a cable line to the portal of the tunnel and placed on grade in the tunnel. Where the tunnel is lined with cement pipes made in advance, the backfilling must be very carefully done to prevent settling and cracking of the lining at the joints. For a large size tunnel it is usually more economical to line it by placing the concrete directly on the surface of the tunnel.

The rectangular section with inverted arched roof is adopted by the Reclamation Service on many of its projects. This form facilitates the construction; the excavated material can be hauled in cars running on tracks and the side lining and bottom lining are easily applied. The types of lining may be of three kinds depending on the material through which the tunnel is excavated:

First—In hard rock, where no timbering is necessary, and a coat of cement mortar is plastered on the rock.

Second—In firm soil, where no timbering is necessary, or where temporary timbering can be removed when the lining is put on.

Third—In loose rock or soil which requires timbering either on roof or roof and sides. The concrete lining is put on, the timbers remaining in the concrete.

The thickness of the lining may range from 2 to 8 in. when in compact rock and 8 to 12 in. when in loose earth or fissured rock.

Truckee-Carson Project Tunnel Lining.

On the Truckee-Carson project, Nevada, four tunnels with a total length of 2937.7 ft. have been constructed according to methods two and three. The carrying capacity of these tunnels is 1200 second feet

Portal to Tunnel on Tieton Main Canal, Washington.

with a depth of water of 13 ft. and a velocity of 8.10 ft. per second. The tunnel sections have vertical sides 12 ft. apart and a horizontal floor. The roof is a three centered arch, 3.35 ft. high for three of the tunnels and 4.35 ft. high for the other. The height at the center is 15.35 with maximum depth of water of 13 ft.

When method one is used, the timbered sets are 8 in. x 8 in. lumber forming an arch of 4 segments, the sets are spaced as widely as deemed safe, depending on the material encountered, any vary from 2 to 6 ft. on centers. The concrete lining on the bottom is 4 in. thick, on the sides the lining is 12 in. thick (4 in. thick at the timbers) and at the center of the arch 16 in. thick. Tunnel No. 3, which is 1515 ft. long, has a thicker arch lining than the other three tunnels. For part of its length, where the ground was very loose, the concrete lining was reinforced with railroad rails. The timber spacing was 4 ft. for most of the tunnel. With the exception of 150 ft. the material through which the tunnel was excavated was silt and cemented gravel that worked easily. The actual unit cost of the tunnel is as follows:

Cost per lineal foot of driving and timbering	**$23,764**
Cost of concreting per cu. yd. excepting cement	**6,596**

(To be continued.)

READINESS TO SERVE METHODS

ELECTRICITY IN THE DAIRY AND CONSERVATION OF FARM PRODUCTS.

BY R. B. MATEER.

The dairy on many of the large ranches is susceptible to economical operation by the use of the small motor and to a greater degree than any other portion of the farm where manual labor was at one time a necessity.

In the search for labor saving devices, many practical motor applications resulted, securing to the farmer maximum economy. Compare, if you please, the former method of milking the cows, the tiresome and continuous opening and closing of the fingers, the uncomfortable position of the milker and the lack of sanitary surroundings, with the now successful milking machine, its cleanliness, its ease of operation and the reduction in hired help, rendering the dairyman independent. Under ordinary conditions, the labor saved aggregated from thirty to forty per cent and permits of the employment of more responsible and better salaried men.

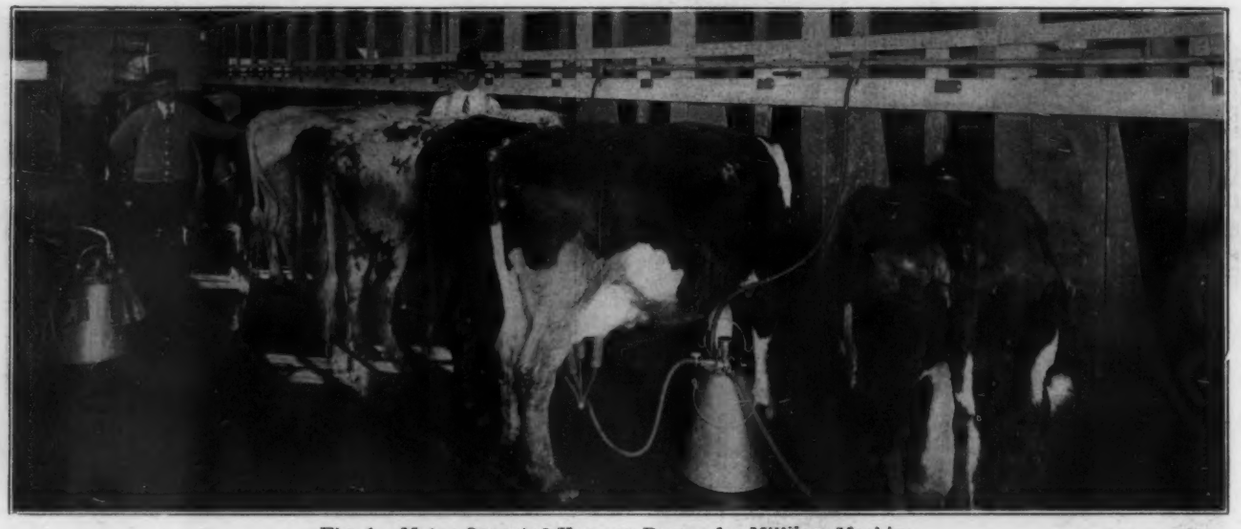


Fig. 1. Motor Operated Vacuum Pumps for Milking Machine.

One of the successful milking machines consists of the can or receptacle and the machine. The milking machine consists of a cover which fits air tight on the receptacle by the use of a small rubber gasket. Mounted on the cover is a frame, a pair of vacuum pumps and two double valves. The pumps are operated through a crank shaft and a small electric motor. Connected with the shaft is a drive which places the double valves in motion. A small gauge indicates the degree of vacuum in the can and a needle valve under the small gauge controls and regulates the amount of vacuum necessary to milk the cows. Attached to the double valve is a rubber tubing and the teat cups. It is claimed that in an hour's time 30 cows can be milked, yet a conservative estimate, when the labor of the man who removes the milk is considered, would be from 10 to 12 cows per hour.

The milk secured is then separated. A machine with a capacity of 1300 pounds per hour and operating on a 1½ horsepower motor requires only 0.0386 kilowatt hours per 100 pounds.

Again where it is desired to market dairy products the churn may be used, and at a comparatively small cost a fancy table article produced. A 100 gallon churn belted to a motor of two horsepower capacity requires approximately 0.617 kw.-hr. per 100 pounds at a cost of $0.01851 exclusive of labor and depreciation or $0.24 for churning and working the butter, when such cost items as labor, etc., are included. From this it is evident that electric service is not alone the servant of the large dairyman, but also of the small ranchman.

Conservation.

Thousands of acres are planted with bearing trees of many varieties and an equal number of acres are producing vegetables such as potatoes, and beets, the yield per acre surpassing the average season's consumption. Shall the fruit go to waste, the vegetables decay, or will the surplus be utilized so as to produce a food for man and cattle? It is possible to treat the product so as to yield a marketable commodity?

Few farmers consider the beet as growing a leaf, which, properly dried, is an excellent food for cattle, and until a few years ago, the content of sugar in the beet was unknown, yet today thousands of acres of beets of a sugar content of from 12 to 20 per cent are grown, and beet sugar is as popular as that of cane.

Potatoes may be cleansed, dried, peeled, cut into cubes and dried again, a feasible method of overcoming waste.

Fruits and grapes that are solid, and showing no

trace of decay, are carefully packed and shipped to other markets; but is it fair to nature that the bruised fruit should be permitted to waste? Apple cider or grape juice finds a ready market and returns a reasonable profit on the investment necessary for the electrically operated press.

Fruits may be cured and a delicious flavor retained where easily regulated electrical heating elements are installed.

Again, all fruits are rich in sugar, containing from 5 to 30 per cent, a by-product, if you wish, readily obtained from fruit which may not be selected for shipment. Through the use of electrically operated apparatus, even a fair profit accrues to the farmer by the sale of his grapes, in order that the sugar content

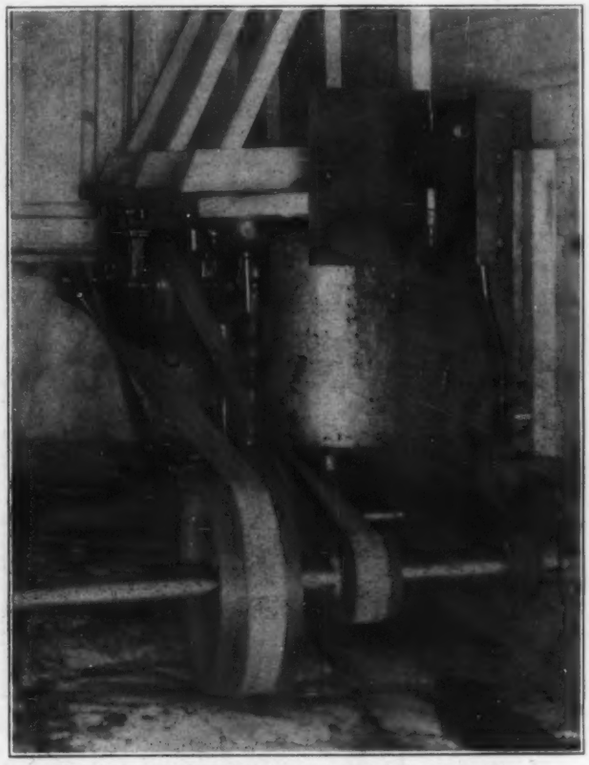


Fig. 2. Electrically Operated Milking Machine.

may be utilized instead of permitting the fruit to dry on the vine and waste, possibly due to the sluggish market for wine and alcoholic by-products. Even when the juices are extracted, the pumace, often wasted, is valuable as a fertilizer for the soil.

Many vegetables grown in large quantities and resulting in an over production may on analysis yield to a mechanical process, which returns in other forms a profit greatly in excess of that contemplated when the seed was placed in the soil.

Consider again, if you will, the potato, even the leaves of which vegetable, when dried, are an excellent food for cattle destined for the market, by reason of the fattening qualities possessed by the dried leaf.

Conservation of our resources has heretofore related only to our natural supplies, such as timber and mineral wealth, yet may it not be of equal or more importance that investigation be made with a view of utilizing for foodstuffs the vegetable and its leaf, distilled products or utilizing it for food instead of applying the torch? Agriculture is not the robbing of the soil of her best, but in applying scientific principles, which convert even the worst growth to a marketable by-product. To accomplish results, of this character, electrically operated apparatus is necessary that the cost per unit of by-product be such as to allow a good margin of profit. Descriptions of apparatus for farm purposes might continue as long as human intelligence and ingenuity constantly strive to provide the farmer with applianaces with which to reduce to a minimum of expense the labor, at one time necessary, to produce his crop, and how to utilize the surplus in by-products, or conserve it for future use.

A PRIMARY STANDARD OF LIGHT.

BY LEONARD HIRSHBERG.[1]

A true standard of light must offer units of length, duration, and mass, which no present standard does. Burner dimensions and fuel consumption or composition, used in many so-called standards, are by no means fundamental measurements. A real primary standard is such a quantity as is actually used in the luminous flux, with a unit called the lumen. Luminous flux, is flux of radiant energy of a certain quality, in virtue of which it is useful for illumination; the energy possessing, in short, the capacity to arouse through the eye the sensation of light. There are naturally two sides to such a luminous flux, to wit: the external or physical source of light, and the human, internal, or psychological interpretation of the source. The rate of flowing, radiant external energy is expressible in physical units, while the unit of the sensation of light, the psychological portion that determines the efficiency of that physical source, must be the coefficient.

Hence there must be an energy unit of light flux in agreement with a given unit of sensation. One watt of radiation of a maximum luminous efficiency as the unit of the source is proposed and it is suggested that this be determined by measuring both light and radiation with a selected monochrome radiation of known efficiency. The mercury green line (.546 m) lying close to the maximum of visual sensibility was thought suitable.

In order to make any such suggestion of use, it is necessary to establish a relative efficiency for various radiations, to determine the luminosity of the average eye for the normal spectrum. To do this it is necessary to have a method which shall make possible the measurement of lights of different color. This was until recently impossible.

The determination of the relative brightness of different colored lights has always been a difficult and unsatisfactory process. Various methods such as visual acuity, persistance of vision, equality of brightness, and flicker, have been employed in the attempt to evaluate the different qualities of radiation on the basis of their common attribute of brightness. Even such psychic factors as change of color with decreasing illumination—the socalled Purkinje phenomenon—has been tried.

The radiations from a source of light must be measured according to their value as light producers

[1] A. B., M. A., M. D. (Johns Hopkins).

in terms of the radiation of maximum light-producing power. The ratio of the sum of these to the whole gives the efficiency of the radiation expressed as a percentage of what it will be were all the radiation of maximum light-producing power.

This efficiency is exactly parallel with lumens per watt. It is in fact, the ratio of the lumens per watt of the radiation from the light source compared to the maximum possible ones. It is necessary to know only the maximum possible luminous output in order to determine the luminous efficiency.

The absolute value of the unit of flux may in general be found by measuring both in light and energy units, a radiation of known luminosity. The problem of determining the mechanical equivalent of light now becomes identified with the establishment of the primary standard, since this is specified by the least mechanical equivalent. Finally, then, Mr. Ives of the National Lamp Association of Cleveland, Ohio, now brings forward in addition to his contributions last year in the Philosophical Review, the proposition that the unit of luminous flux be defined as the flux from a source which radiates energy of maximum luminous efficiency at the rate of one watt. The method of estimating luminous efficiency, and the method of colored-light photometry which it is necessary to adopt before a primary standard of light can be established, is now presented for the first time.

LIGHTNING PROTECTION OF TRANSMISSION LINES

BY ALFRED STILL,
Member A. I. E. E., Inst. E. E.

Methods of Relieving Conductors of High Potentials Before Damage Is Done to Insulators or Machines and Apparatus Connected to the Line.

Water jet arresters.—By directing a stream of water from the nozzle of a grounded metal pipe on to the high tension conductors, a high resistance non-inductive path to ground is provided for the extra-high potential charges on the line; but there will be very little leakage of power current. Arresters constructed on this principle have been found useful in practice; but the employment of jets of water has its objections. It is usual to put the jets in action only at times when electric storms are pending; and the reliance on the "human element" renders the apparatus less valuable than an equally effective device which is always ready to act. Patents have been granted for various forms of water jet arresters, but they are not extensively used at the present time. The chief function of the water jet is to prevent the building up of static pressures on the line.

Spark gaps.—Nearly all lightning arresters are designed on the principle of one or more spark gaps between the conductors and ground, the air space being so adjusted that the normal difference of potential between the line and ground is insufficient to jump the gap; but abnormally high pressures will break down the insulation of the gap, and so find a path to ground before the pressure is sufficiently high to damage the insulation of the line or the apparatus connected thereto.

Horn gap.—The ordinary horn gap arrester of the type shown in Fig. 3, is so well known it requires no detailed description. When the potential rises to such a value that it can jump the gap at the base of the curved wires, the power arc will follow the discharge; but, owing partly to the upward tendency of the heated air, and mainly to the magnetic field produced by the current itself, the arc is driven upward toward the ends of the "horns" where, after being sufficiently drawn out in length, it is finally ruptured. The horn gap is not effective when set to discharge at pressures below 13,000 volts, because, with a small gap (less than 1 in.), the arc may not rise and break properly. The usual settings for horn gaps are as follows; the

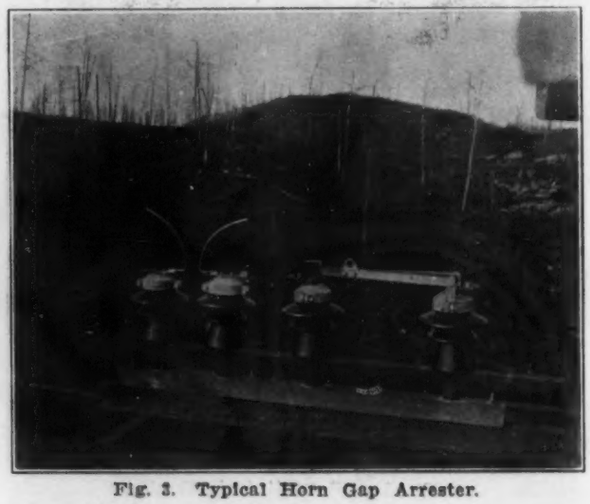


Fig. 3. Typical Horn Gap Arrester.

figures referred to as "voltage" being the approximate breaking down potentials:

Voltage.	Gap.
25,000	1½ in.
50,000	2½ in.
75,000	4½ in.
100,000	7½ in.

A non-inductive resistance should be connected in the ground wire from the horn arrester. An ordinary wooden barrel filled with water, with a connecting plate at the bottom, and the upper terminal carried about 6 in. below the surface of the water, makes an effective resistance. If no resistance is provided in the ground connection, the momentary discharge of the power current may be excessive, and there is the possibility of synchronous machines being thrown out of step.

One serious disadvantage to the ordinary horn gap arrester is the liability of an intermittent arc setting up surges and high potential disturbances which may lead to more trouble than the original cause of

the spark-over. Fairly satisfactory results have been obtained by providing a number of horn gaps on a high tension transmission and "grading" these, by adjusting some of them to discharge with a very small rise of pressure through a high resistance; while other sets would have larger gaps and lower resistances in series; the very largest gap being such as to break down only rarely, under exceptionally high pressures, and this should have a very low resistance in series, but may with advantage be protected by a fuse.

Horn arresters, if intelligently placed and properly connected and adjusted, are capable of affording good protection; but the multi-gap and "low equivalent" arresters, as originally suggested by Mr. P. H. Thomas, have some special features which have led to their frequent adoption on a.c. circuits for pressures up to about 40,000 volts.

Multiple-Gap Low Equivalent Arrester.

In this type of arrester there are many air gaps in series between the line and ground. No single gap is greater than 1/32 in. or 1/16 in. and it occurs between the adjacent surfaces of small cylinders made of

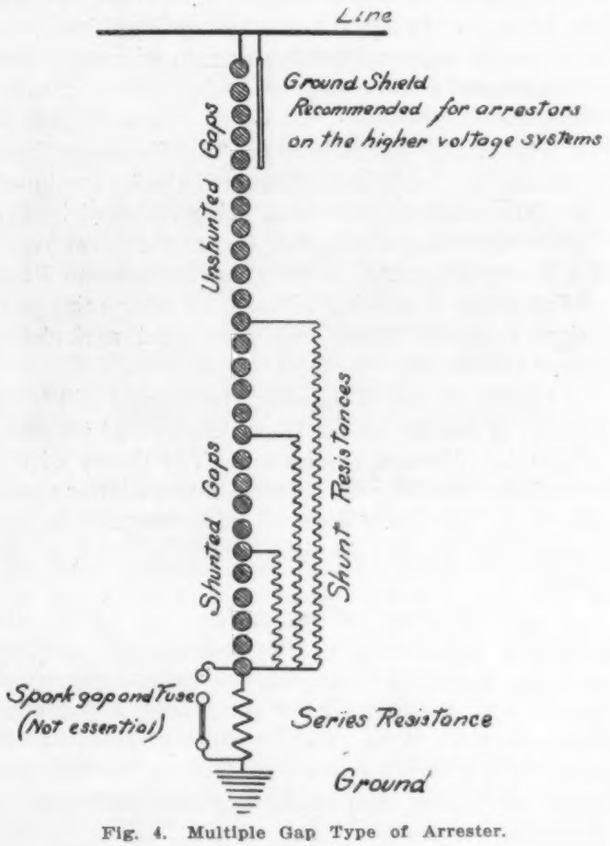


Fig. 4. Multiple Gap Type of Arrester.

a so-called "non-arcing" metal as used in the earlier types of Wurts arrester. The number of gaps in series depends upon the working voltage of the line, and the last of the metal cylinders is connected to ground (or to one of the return conductors, as the case may be) through a non-inductive resistance, which may, with advantage, be shunted by a fuse in series with a spark gap. Sometimes a portion of this resistance is bridged by a number of spark gaps, all as shown in the diagram Fig. 4. These shunted gaps act as a sort of by-pass for heavy discharges, the amount of the unshunted resistance, through which all discharges have to pass, being comparatively small. The theory of the low equivalent arrester has been ably discussed by other writers.[1] Its action is, briefly, as follows. There is a certain electrostatic capacity between consecutive cylinders, and between each one of these cylinders and ground; and the potential gradient is considerably steeper at the high voltage end of the arrester, with the result that, when the total voltage across the arrester reaches a certain critical value, the break-down occurs between the first and second cylinders. The second cylinder is then connected to the first by an arc, so that its potential rises accordingly, until a break-down occurs between the second and third cylinders; and so on. The line current then follows the discharge, and in so doing, tends to produce a uniform fall of potential along the line of cylinders, with the result that the maximum potential difference between cylinders is considerably less than that required for the initial break-down, and the power arc is ruptured. When a break-down occurs between two cylinders, the potential of the lower cylinder of the series will depend upon the quantity of electricity which passes to it from the more highly charged cylinder. The initial current is really a capacity current, and it will therefore be greater at the higher frequencies; but, by a scientific proportioning of the shunted resistance, a very satisfactory arrester of this type can be made, for use on circuits up to about 13,000 volts: it is less effective on higher voltages, but is actually used on 20,000 volt, and even 35,000 volt transmission lines.

The multiple gap arrester is essentially adapted for dealing with line oscillations; but a heavy high frequency discharge will generally jump a straight gap over insulation several times greater than the equivalent insulation of the arrester; and, for these reasons, a judicious combination of the horn gap and multiple gap arresters is to be recommended.

One reason why the multiple-gap low equivalent arrester is not satisfactory on very high voltage systems is that the necessary increase in the number of gaps to prevent arcing over by the line voltage alone is out of all proportion to the increase in voltage. There is also much uncertainty as to the number of gaps required, as this seems to depend on the position of the arrester relatively to surrounding grounded objects. With the ground potential brought very near to the arrester, the potential gradient at the end near the line frequently becomes high enough to ionize the air between the cylinders, thus carrying the line potential to lower cylinders, until the remaining gaps are so few that a discharge occurs. In order to obtain the more equal division of the total potential difference, and so allow of a reduction in the total number of gaps, such as would be obtained by removing the whole arrester to a considerable distance from grounded objects, a metal guard plate or shield is sometimes placed near the gaps at the high potential end of the arrester, and connected to the line wire as indicated in Fig. 4.

(To be continued.)

[1] See Dr. Steinmetz on the theory of this type of arrester in Vol. XXV (1906) of the Proceedings of the A. I. E. E.

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POWER AND GAS

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NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

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FOUNDED 1887 AS THE
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The New Year

This is the season of New Year's resolutions—a time as described by the old German professor, "to vipe id all oud." The editors of the Journal at this time would wipe out of their consciousness any ambitions they may have for its future which ring not of the highest and sincerest tone. They desire to take advantage of this opportunity to thank its readers and friends for the hearty, whole-souled support given them during the past year. The year just completed finds our standards raised much higher toward our ideals and a financial and moral support hitherto unexperienced.

The Journal has high ideals of accomplishment for the immediate future. Subjects of timely interest, discussed in its columns, which have proved of such widespread comment during the past year, will be continued with new and enlarged vision.

"Electrical Pumping and Irrigation," which is now being followed by our readers throughout the great irrigable districts in the West, will be continued, and the Journal will endeavor to maintain its unique position among technical publications in discussing this all-important present adjunct to hydroelectric salesmanship.

The timely discussions on "Readiness to Serve Methods" applied to agriculture will also be continued. The data which is each week being collected by Mr. Mateer, agricultural sales manager of the Great Western Power Company, in the great Sacramento Basin of California, is proving of value to other sales campaigners of the West, looking toward agricultural power possibilities.

In early issues of the year, the Journal will begin a series of articles on the Diesel engine and its possibilities for Western application. The theory of this remarkable engine will be gone into and the reader lead by simple direct steps to grasp the fundamental, efficient thermodynamic principle upon which it operates.

Auxiliary steam plants, which have become the steadying factor of Western hydroelectric practice, will also be treated in our columns by an authority on elements of design. Wrinkles in wiring and conduit laying in large Western cities will be treated by one now in the midst of this work. Our readers will gain many new ideas of methods employed and technical principles involved.

To form a climax of our endeavors for the new year, an epitome of great engineering achievements, which make the West stand forth as world-beaters, is being prepared largely by many of those who have personally mastered these great triumphs. These articles, forming in the aggregate a harmonious whole, will appear from time to time during the year.

Soliciting, then, the hearty co-operation of all in our earnest efforts, we desire to wish one and all the happiest and best New Year ever before experienced.

Electricity in the Dairy

Some months back when mechanically operated milkers first came upon the market, the great manufacturers of milk products of the West advised their farmer clients not to use them, due to the injury such apparatus seem to bring upon the teats of the cow after continued applications. Those, however, who have seen the new application for electrical energy in the way of the vacuum process of milking, an illustration of which is shown elsewhere in this issue, cannot help but marvel, as the dentist would say, "at this apparently painless extraction."

Few who have enjoyed early boyhood days on the farm can keep from recalling with a shudder the early morning hour with the cow. The cold fingers, the cramped position—all roll by in memory's vision. Today, however, the farmer seems to be getting every modern refinement and nicety in invention—all of which makes a happy smile loom over the face of the agricultural power salesman.

A New Year's Suggestion

Thanksgiving is past, Christmas has come and gone, the New Year is upon us. Let us be thankful for things accomplished and at the same time purpose to make a better, cleaner log-sheet for the coming season's run.

The outward personal attitude with which we attire ourselves in our daily work has indeed much to do with actual results attained. This attitude, though unexpressed in words, yet reflected from the countenance of either employer or employee in the modern utility company, speaks its silent message in an "eye-language" not only distasteful and depressing to all observers, but it actually brings about inefficiency in results accomplished.

In the building of a great transcontinental railroad wherein are often employed laborers of the lowest type, morally and mentally, perhaps the rule by the club may at times prove the more effective. Perhaps the display of three armies of laborers—one coming, one going, and one actually on the job—often overpowers the "bohunk" laborer by arousing within his inner make-up all the pangs of fear inbred in his nature and handed down to him as a precious heritage from days of savage splendor. In the modern highly scientific and keenly developed mind of the utility employe, however, the rule by club has no place. Nor is there any room upon the employer's countenance for an attitude of nonchalance.

The cry of the day is service—maximum service at minimum cost. The keynote of service is loyalty—a loyalty that makes employer and employe stand or fall together in the operation of a public utility.

The question is often asked, how may loyalty be best induced in a great public utility? Many have presumed to answer this question—few have actually solved the riddle. Needless to say, the first and foremost step is to wipe from the countenance that certain attitude. As soon as this is accomplished, and an approachable outlook begins to emanate from the chief's down through the sub-chief's offices, it is wonderful how quickly this subtle quality, "loyalty," is engendered. Inded, loyalty is the vital fluid generated by the establishment of a sympathetic field of force between employer and employe, more subtle and yet more powerful than the force lines emanating from the dynamo. Loyalty, too, is more delicate than the violet, and this sprinkling of a sympathetic relationship from employer to employe meets the instant response seen when upon the withered violet water is gently sprayed.

If now you ask what this state of mind is, what the three small word adjective is by the removal of which such wonders may be wrought, we appeal to you to forever remove from your countenance, if ever it were there, and cast into the bottomless pit that "Go-to-h——" attitude.

Interurban Aids in Oregon

As our leading article of this issue is devoted to an extensive description of the interesting network comprising the holdings of the Portland Railway, Light & Power Company, the subject of interurban aids in the upbuilding of the West is certainly not amiss. An analysis of the last national census of both Eastern and Western cities truly indicates that city and rural growth has followed always the bold leadership of the pioneers in interurban electric line construction. Cleveland, Detroit and Indianapolis are striking Eastern examples, while Spokane in the Northwest and Los Angeles in the Southwest have proven themselves emphatic Western examples of the stimulating effect of such far-sighted generalship.

During the past six months, Portland and, indeed, almost every nook and hamlet in Western Oregon, has been interlinked with electric lines. Portland will thus unquestionably arise in the near future as a possible supreme leader in Western enterprise and growth. The beauty of electrification is, however, that big city centers are not alone encouraged. This blessing of interurban electric railways, like Portia's dream of mercy, "is not strained; it blesseth him who gives and him who takes." The rural community and city alike feel its invigorating, "ozonized" life.

The Portland, Eugene & Eastern alone is preparing to operate over 340 miles of track, and, when thus completed, there will be nearly 700 miles of electric interurban tributary to Portland. Oregon as a State may well value this new and enterprising work as one of her most substantial assets.

It is indeed surprising that the great metropolitan district in Central California still lacks interurban electric facilities in keeping with its growth. The Oakland, Antioch & Eastern, soon to be in rail connection with Sacramento, will do much in making a substantial start. Still, the beautiful Santa Clara Valley, the city of San Jose, and countless other prospects but awaiting the magic touch, lie disconnected electrically. The bold, fearless policy displayed in and about Portland, in arising to the possibilities of electrification, is indeed to be commended.

PERSONALS

ITEMS FOR THIS DEPARTMENT ARE SOLICITED FROM ALL READERS

PERSONALS.

Geo. S. Nickerson, a mining engineer of Eureka, Nevada, is spending a few days in San Francisco.

R. C. Pollard, of the Pa-cific Gas & Electric Company's engineering staff at the Drum Power House, has returned to San Francisco to remain over the winter months.

T. H. Nelmes, formerly of the Great Western Power Company, San Francisco, has become associated with the sales force of the Pacific States Electric Company.

L. E. Sperry of San Francisco, **B. C. Chase** of Los Angeles and **H. G. Behnemann** of Seattle have been appointed selling agents for W. N. Matthews & Brother of St. Louis.

A. E. Wishon, assistant general manager San Joaquin Light & Power Company, who has been on an extended absence from Fresno over the holidays, is again at his desk.

Frank A. Binford, Jr., assistant to W. D'A. Ryan, illuminating engineer for the Panama-Pacific Exposition, left for Schenectady, N. Y., on New Year's day. Mr. Benford expects to be in the East for several months.

W. J. Heger, Jr., formerly hydraulic engineer with F. Numa of Oakland, Cal., having just returned from an Eastern tour of inspection, has opened offices in the Rialto building. San Francisco, to handle irrigation pumping plant installations as a specialty.

Ralph S. Phelps, Pacific Coast manager of the Safety Insulated Wire and Cable Company, expects to leave within the next week or ten days for the East. **Herbert Smith,** his assistant, will accompany him, and about the first of February will bring an Eastern bride to California.

J. A. Vandegrift has been elected the first president of the newly organized Electrical Development League of Alameda County. It is proposed that the new organization pursue similar lines of development work in Alameda County as the Electrical Development League of San Francisco.

C. H. Gaunt, formerly general superintendent of the Western Union Telegraph Company, has been promoted to the position of general manager of the Pacific Division of that company with headquarters in San Francisco, while H. F. Dodge becomes assistant general manager, with headquarters in the same city.

F. L. Hutchinson, secretary of the American Institute of Electrical Engineers, has notified **Charles C. Moore,** president of the Panama-Pacific International Exposition, of the formal acceptance of the invitation to hold the meetings of the International Electrotechnical Commission and the American Institute of Electrical Engineers at San Francisco in 1915.

B. S. Josselyn, president of the Portland Railway, Light & Power Company, was presented with a scroll containing the signatures of 1000 employes, testifying to their appreciation of his efforts in their behalf during the closing year. A committee, headed by Franklin T. Griffith, delivered the gift. Mr. Josselyn responded to the address of presentation in a feeling manner.

Louis R. Glavis resigned as secretary of the California conservation and water commissions this week. It is proposed to increase the water commission to five members, the governor and state engineer, ex-officio, and three appointive at $25 per diem, with a minimum of $5000 annually. The new law also proposes forty years as the term of license for the use of water for power purposes.

Walter Cook, New York, has been re-elected president of the American Institute of Architects; **R. C. Sturges,** Boston, first vice-president; **F. C. Baldwin,** Fredericksburg, Va., second vice-president, and **Glenn Brown,** Washington, D. C., secretary-treasurer; **B. L. Fenner, C. G. La Farge, H. Van Buren Magonigle,** all of New York, were elected directors for the three-year term, and **Robert Stead,** Washington, D. C., auditor.

LETTERS TO THE EDITOR ON EXPOSITION WIRING.

The following letter, which is self-explanatory, was received by the editors of this journal. The editors are also in receipt of another letter from the exposition authorities which is also of timely interest to all concerned, and which appears below:

San Francisco, Cal., Dec. 18, 1912.

Dear Sir: The specifications for the Machinery Building for the Panama-Pacific Exposition are now in the hands of the general contractors and I notice that the exposition company has cut all the electrical work out and propose to install this work themselves by day labor.

While I have no doubt that they may have a good reason for taking this course, still it is not apparent on the surface and it is just to the electrical contractors in this city that the reason should be given.

Several of the contracting firms have been put to heavy expense retaining on their staff high grade employees, which the conditions of the business, during the last two or three years, have not warranted and they have incurred this expense anticipating that the exposition work would require a large force of men competent to carry out this work with promptitude and success; while now it appears that if this program is carried out the electrical contractors will receive no benefit whatever from the business induced by the fair.

I feel satisfied that the Exposition Company can contract much of their work cheaper than they can do it themselves by day labor.

Yours, etc.,
A. E. BROOKE RIDLEY,
Electrical Engineer and Contractor.

San Francisco, Cal., Dec. 26, 1912.

Dear Sir: Replying to your letter of the 23d inst. and the letter from Mr. A. E. Brooke Ridley, which I return herewith, I beg to inform you that the reason the electrical work was not included in the specifications recently issued for the Machinery Building, was that the plans for wiring depend upon such factors as the exterior and interior lighting and power distribution, concerning which full data was not available at the time the building specifications were written.

Before the building is advanced to the stage where wiring could be done to advantage, it is planned to issue plans and specifications and request bids for the electrical work involved.

Submitting the foregoing for your information I remain,
Yours very truly,
G. S. BAYLEY
Chief M. E. and E. E., Panama- Pacific International Exposition Company.

TRADE NOTES.

The Johns-Manville Company are now occupying offices and lofts in their new building on the northwest corner of Second and Howard streets, San Francisco.

The Cincinnati office of the Fort Wayne Electric Works, which has been at No. 1125 Union Trust Building, has been moved to Nos. 704-5, Provident Bank Building, on account of the Gibson House fire. This fire practically destroyed the Union Trust Building, and made a change on the part of the company absolutely necessary. The company is planning to maintain an energetic sales campaign in the immediate future.

COMMUNICATION FROM THE UNDERWRITERS' EQUITABLE RATING BUREAU.

There seems to be a general misunderstanding regarding the Refillable Type of Cartridge and Enclosed Plug Fuses. The Underwriters' Laboratories, Inc., have never approved any type of refillable fuse and offer the following criticism on this type (Underwriters' Laboratories Card No. 3274 dated September 20, 1911; name of submitter, A. F. Daum Company, 504 Diamond street, Pittsburg, Pa.): "Refillable Fuse Casings, 250 and 600 volts, all capacities. Fibre tubes threaded for metal cap terminals. Designed to be used with renewable fuse wires clamped at ends of casings between washers and the threaded caps and filled with shredded asbestos packing." Report July, 1911: "Examination and tests of samples of Daum fuse casings indicate that, while a certain degree of protection may be secured by them when used with fuse elements suitable to the circuits of which they are a part, their construction is not such as to insure proper assembly and use under all conditions of service. The ease with which fuse elements of unduly large size or of wholly unsuitable material may be used in them without external evidence of such misuse is judged a serious defect. Under conditions liable to be met in practice, these casings are not considered to be the equivalent of standard cartridge enclosed fuses or of properly rated open link fuse, suitably enclosed in fireproof cabinets either in respect to the protection they afford to electric circuits or in freedom from hazards incident to their operation." The other fuses of this type, which have been submitted to the Underwriters' Laboratories, Inc., and have been criticised are the following:

Herman Oicovich & Son, 625 Market street, San Francisco, Cal., and Geo. R. Willet, Pittsburg, Pa.

In addition to the manufacturers who have submitted this type of fuse to the Underwriters' Laboratories, Inc., for their approval, there are quite a number of manufacturers who also make this type of fuse and sell same.

Many times manufacturers of unapproved fuses, advertise their products in a way to mislead the public. For instance the following wording has been used in their advertisements: "In presenting this catalogue to the electrical industry, we wish to announce a Renewal Cartridge Fuse, which to the best of our knowledge, is the first device of its kind designed and constructed to meet the specifications of the National Board of Fire Underwriters, whose rulings govern the use of a device of this nature."

Therefore, we beg to call to your attention that this Bureau sanctions only the use of fuses, which bear the proper Underwriters' label. A list of approved manufacturers can be found on pages 28 to 31, inclusive, April, 1912, List of Electrical Fittings.

UNDERWRITERS' EQUITABLE RATING BUREAU,
F. D. Weber, Electrical Inspector, Portland.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

Dec. 23.

The Escondido Light & Power Company applied for authority to issue and sell at par 49,500 shares of stock, the proceeds to be used in the construction of an electric light plant.

The Palo Alto Gas Company filed an answer to the city of Palo Alto, denying that the rate for gas in the sum of $1.50 for 1000 cubic feet, is unjust or unreasonable.

The Los Angeles Railway Company filed its answer to the complaint of the city of Inglewood, denying charges of unjust rates in its suburban service in Los Angeles county.

The Coalinga Water & Electric Company applied for a certificate of public convenience and necessity to operate in San Luis Obispo, Monterey and Santa Barbara counties.

The Great Western Power Company and the town of Suisun applied for an order directing that the power company be permitted to use the poles of the Pacific Gas & Electric Company and the Pacific Telephone & Telegraph Company in the town of Suisun, for the purpose of stringing its wires.

Dec. 24.

The San Dimas Water Company filed application for the purchase of the San Dimas Irrigation Company, the Artesian Belt Water Company and the Charter Oak Reservoir Company, and asked for authority to issue 2000 shares of capital stock of the par value of $100 each, and to sell $100,000 of bonds.

The Stockton Terminal & Eastern Railroad Company applied for authority to issue $378,000 of bonds, to be used in extending its line running out from Stockton.

The Palermo Land & Water Company applied for permission to make increases in the charges for water.

Dec. 26.

The Terra Bella City Water Company, of Terra Bella, Tulare County, applied for permission to purchase a water plant from the Terra Bella Development Company.

Dec. 27.

The city of Santa Paula filed a complaint against the Santa Clara Water & Irrigating Company and against the Interurban Land Company, alleging that the open ditches in Santa Paula were unhealthful and a public nuisance. The complainant asked that the irrigation companies be compelled to substitute submerged pipes.

SAN FRANCISCO ELECTRICAL DEVELOPMENT LEAGUE.

Mr. T. E. Bibbins, who was elected president at the December meeting of the Electrical Development League, announces the following as the personnel of the various committees to serve during the ensuing term:

Entertainment Committee.
J. G. De Remer
Stanley Walton
G. I. Kinney

Membership Committee.
W. L. Goodwin
W. Brewster Hall
S. P. Russell

Ways and Means Committee.
H. V. Carter
W. S. Berry
E. B. Strong

Finance Committee.
C. E. Wiggin
W. W. Hanscom
Lee H. Newbert

Goodfellowship Committee.
J. A. Vandegrift
A. E. Drendell
F. J. Cram

Grievance Committee.
P. Decker
Garnett Young
G. C. Holberton

Publicity Committee.
A. H. Halloran
J. W. Redpath
Guy L. Bayley

The next meeting of the League will be held at the usual meeting place Tuesday, January 14. Let all attend and start off the League's first meeting of the new year with a rousing attendance.

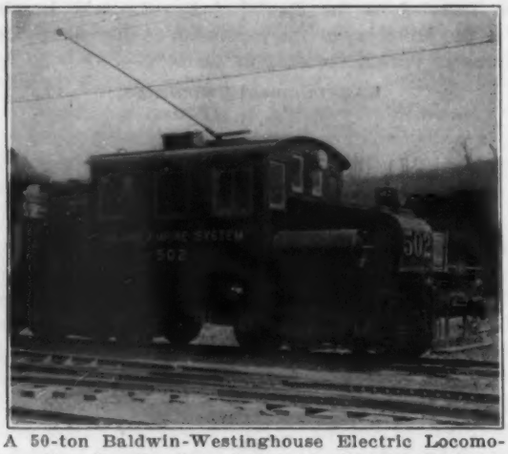
INDUSTRIAL

WESTINGHOUSE ELECTRIC LOCOMOTIVES IN THE WEST.

A 50-ton standard-gauge Baldwin-Westinghouse electric locomotive, suitable for yard service, has recently been furnished the Spokane & Inland Empire Railroad Company for use in Spokane.

Four Westinghouse No. 301-D-2 motors, geared with a ratio of 17:60 to 37¼-inch wheels and Westinghouse HL electro-pneumatic control are used. A double and E. L. type automatic brake equipment is employed, and air for the braking and control systems supplied by two D-3 motor-driven compressors, each having a displacement capacity of approximately 35 cubic feet of free air per minute. A hand brake is provided for holding the engine when it is stored up in yards.

The locomotive is designed to traverse curves of 34 feet radius when running without a trailing load, and the longitudinal frame sills are four in number, consisting of 12-inch channels. Strong diagonal bracing, consisting of 1½ x 6-inch bar iron, is used on each side of the frame between the middle and outside channels. The cab is of steel, and centrally located. It has a length of 12 ft., and a width of 9 ft. 3 in., and may be entered from either end. Controlling equipment is installed in duplicate, the locomotive being arranged for double-end operation.



A 50-ton Baldwin-Westinghouse Electric Locomotive for the Inland Empire System, Spokane, Washington.

One air compressor is mounted under one of the hoods of the cab, and under the other hood of the cab is mounted a second air compressor and blower. This motor-driven blower supplies air for ventilating the traction motors. The motors and auxiliary apparatus have sufficient capacity to enable the locomotive to exert continuously a tractive effort of 9400 pounds with 600 volts at the motors, with average wheel diameter of 36 inches. It will also exert a tractive effort of 16,000 pounds at approximately 9.2 miles per hour with 600 volts at the motors. With clear, dry rails it will be able to exert momentarily a maximum tractive effort of 25,000 pounds.

ANOTHER PHASE OF THE TELEPHONE'S VERSATILITY.

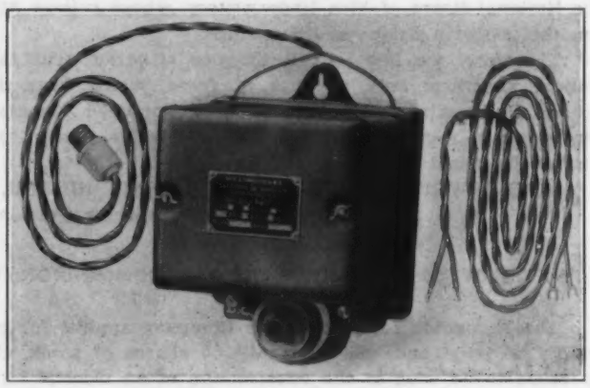
The entertainment which was presented by the New York Telephone Society and participated in by members of the American Telephone, New York Telephone and Western Electric Companies was a satirical musical hodge-podge entitled "Examinations," a travesty of an examining board inviting applications for positions at the telephone business. The part of the Western Electric Company was portrayed by W. D. Lindsey, of their advertising department, who was assisted by a wooden dummy designated as "The Very Latest Product of the Factory."

The dummy not only talked well but moved his arms, head and jaws in such a manner that the act seemed to be a perfect marvel of ventriloquism. What no one suspected, however, was the fact that concealed ingeniously in the body of the dummy was a Western Electric "loud speaking telephone" which was connected to a transmitter behind the scenes by means of wires running down the feet of the chair to contact sockets on the floor of the stage. The telephone end of the "ventriloquial" conversation was conducted by P. M. Rainey, the designer of the dummy, and a further feature of the act was the rendering of songs by means of a phonographic attachment.

This very unusual use for a telephone instrument is but another illustration of the remarkable commercial versatility of the new loud speaking telephones which have already proven their worth as announcers in railroad terminals, baseball parks and exhibition halls. There are, and probably will be found, many more fields of activity, for these remarkable products of the telephone engineer's art, both in and out of the theatre.

TYPE G VIBRATING RECTIFIER FOR CHARGING THREE-CELL BATTERIES.

The apparatus consists essentially of a polarized relay acted upon by two alternating current magnets so that it vibrates in synchronism with the alternations of the current, and arranged to reverse the connection of the circuit as the current reverses. The vibrating arm is magnetized by current from the direct-current side, so that one end is pemanently north and the other end permanently south, depending on the way the battery is connected.



Improved Vibrating Rectifier.

The rectifier can be operated on any 60 cycle alternating current circuit of 100 to 120 volts, and will charge three cells at a rate of 6 to 8 amperes.

To charge a battery all that is required is to connect the attachment plug to a lamp socket and the lower binding posts to the battery. No care need be taken as to which pole of the battery is connected to which binding post, as it is immaterial. Should the supply circuit be interrupted temporarily the rectifier will start again as soon as power is restored to the line.

NEWS NOTES

INCORPORATIONS.

ESCONDIDO, CAL.—The Escondido Light & Power Company; $50,000, subscribed $500, by G. V. Thomas, E. G. Logan, W. W. Prior, M. Conway and C. S. Palmeter.

ROSEBURG, ORE.—Articles of incorporation have been filed for the Umpqua Power, Light & Ice Company. The capital stock of the corporation is placed at $25,000, $17,500 of which is common stock. The incorporators are James Christian Alexander, Attorney J. A. Buchanan and Attorney O. H. Porter. The main office of the company will be maintained in Roseburg. The purpose is to manufacture and sell ice, water, light and power and to engage in a general refrigerating business.

ILLUMINATION.

LOS ANGELES, CAL.—The board of supervisors have sold a county gas and electric franchise to the Los Angeles Gas & Electric Corporation at the rate of $10 per mile.

ELSINORE, CAL.—The Southern Sierras Power Company has applied for a franchise for transmitting electricity in all public streets. The franchise will be sold to the highest bidder on February 10th.

ALBANY, ORE.—Mayor P. D. Gilbert will recommend in his message to the new city council at the first meeting in January that the city install a municipal lighting plant for the maintenance of a cluster light system.

LOS ANGELES, CAL.—The Escondido Light & Power Company has filed an application asking permission to issue and sell at par 49,500 shares of its capital stock, the proceeds to be used for construction of a new electric light plant.

REDWOOD CITY, CAL.—The Halfmoon Bay Light & Power Company has petitioned the board for a franchise to extend the company's lines southward from Halfmoon Bay to the southern boundary of the county. The franchise will be offered for sale on January 20th.

TACOMA, WASH.—The Buckley council has granted a franchise to P. H. Hebb of Tacoma for power purposes, the franchise to run 50 years. Under the arrangement Mr. Hebb agrees to furnish Buckley with power for lighting purposes at less than one-half the rate now being paid.

SAN DIEGO, CAL.—The San Diego Consolidated Gas & Electric Company has just completed the installation of a new 5000 kilowatt turbine, which cost about $100,000, and plan more work for the gas department, which will include a new garage for the company's machines, a gas compressor to serve high pressure lines, two new oil generators, one water gas generator, a lamp black filter, and the construction of new 12-inch high pressure mains from East San Diego to La Mesa.

SACRAMENTO, CAL.—The bids submitted to the city commission by the Great Western Power Company and the Pacific Gas & Electric Company to furnish the city with electrical energy for the next year means a saving of approximately $7500 to the municipality for the next 12 months. The bid of the Pacific company was $5.50 per month per street lamp, which is 50c lower than any record of the city. No bid was submitted by the Great Western. For fire houses and all other public buildings the Great Western was the lowest bidder, the bid being 2¾c per kw.-hr. as against the 3c bid by the Pacific company. The Pacific company was lowest for the electroliers. The same company was also lowest on nearly all motor-power in various public buildings, including the city hall. The city paid the Pacific company during the present year a rate of $6 per street lamp per month. In 1907 the rate was $7.

TRANSMISSION.

PORTLAND, ORE.—The Pacific Power & Light Company announces that it will undertake construction immediately of a power plant at Hood River which will generate 7000 horsepower energy and which will be offered to industrial concerns throughout the valley.

QUINCY, CAL.—The supervisors of this county will on January 9 open bids for the sale of a franchise that has been asked for by the Oro Electric Corporation for the construction of pole and tower lines and the construction of pole and tower lines and the distribution of electricity in Plumas county. Work on the construction of the power line must be commenced in good faith within four months after granting of the franchise and the purchaser must pay to the county five per cent of its earnings after the first five years.

PORTLAND, ORE.—After several weeks of negotiation the Northwestern Electric Company has completed a deal whereby it purchases for approximately $100,000 an acre and a half of ground in Albina to be used as a site for an immense auxiliary steam plant for the generation of electricity. The site was selected after officials of the Northwestern had spent more than two months in looking over the city, and is regarded as an ideal location for the auxiliary generating plant and storage grounds.

FRESNO, CAL.—Electric power for San Miguel and Paso Robles has been turned on by the San Joaquin Light & Power Company. The new lines, which connect the valley and the coast have been completed for some time as far as Paso Robles. Workmen are still engaged in building the power line and it will be carried into San Luis Obispo. Almost two-thirds of the territory has already been covered and the wiring will be done in a shome time. When the lines are completed and the power is turned on almost all of the territory above Santa Barbara will be receiving its electric power from Crane Valley. Power for this section of the San Joaquin Valley is derived from the same source.

RENO, NEV.—The Nevada Valley Power Company, having a power site on the Truckee River at the Largamarsino bridge, and having other power sites in the mountains near Reno, has filed a $3,000,000 trust deed with the county recorder here, intending to bond its property for this amount to secure money to build its power plants. It intends to run in competition with the Truckee River General Electric Company. The company, in addition to its power sites, owns land and a number of rights of way. The trustee for this company is the International Trust Company of Denver. The directors are: H. D. Danforth, a local attorney; Edison Adams, Edward Bowes, Milton Hamilton and A. F. Tarley, all of Oakland.

BAKERSFIELD, CAL.—Charles K. Badger, who is in charge of the Southern Sierras Power Company's work at Randsburg, declares that the current will be turned on at Randsburg about the first of the year. The Southern Sierras line is nearly complete and its horsepower is received from Inyo county water power. A line 238 miles in length with eight steel towers to the mile has been built from Inyo county to San Bernardino. The Indian Wells Valley in which live quite a lot of new settlers whose postoffice is Inyokern, the Southern Sierras Company already has sold 1000 h.p. A large amount of horsepower already has been sold to Randsburg parties and mining companies and the opening up of new mines is foreshadowed by the cheapness of the power within reach. The Sierras Company will develop 87,000 h.p. at the start and this will eventually be increased to 150,000 h.p.

TRANSPORTATION.

MEDFORD, ORE.—J. A. Westerlund and C. Y. Tengwald have applied for a franchise to operate a trackless trolley system here.

HERMISTON, ORE.—The Hermiston Light & Power Company has been granted a franchise to extend a line to Echo, work to be completed in 90 days. The company will also light Umatilla.

CENTRALIA, WASH.—The Washington Electric Company has applied for a franchise for right-of-way along the county road from the fair grounds to this city for an electric line. Hearing was set for February 21.

LEWISTON, MONT.—From an authentic source comes information that the road being built by the Great Northern Railway from this city to Rockford, N. D., will be electrified. The electrification will cost $10,000,000.

PORTLAND, ORE.—The Portland Railway, Light & Power Company will begin immediately the construction of the extension of the Hawthorne avenue car line from E 60th and Division streets to E. 74th and 29th avenue.

MOLALLA, ORE.—The Portland, Eugene & Eastern Railway Company officially announces the line will be extended to this city. Work will cost approximately $100,000. The proposed line will be changed from Canby to Silverton.

VANCOUVER, WASH.—The Northwestern Electric Company has petitioned the city council for a franchise to operate a street car and light and power system in this city. The matter was laid over until next meeting so that several amendments could be made.

PORTLAND, ORE.—C. E. S. Wood, counsel for the Northwestern Electric Company, is authority for the statement that that concern will build an electric line up White Salmon River and will also operate a steam line up Klickitat. The concern is ready to expend $20,000,000.

NEW WESTMINSTER, B. C.—Plans for the British Columbia Electric Railway Company's proposed yards, which are to be built here at a cost of approximately $200,000, are now before the city council for approval. Work will start as soon as same are passed on.

LEWISTON, IDAHO.—The City Council will soon be asked by F. L. Sturm, of the Lewiston Electric Railway Company for an operating franchise. Work of constructing the line between Lewiston, Clarkston and Asotin will be started within 30 days after the franchise has been granted.

PORTLAND, ORE.—The Electric Engineering Corporation has been awarded the contract for installing a 1000 kw. hydroelectric development plant on Wind River, Wash., to be used for electric logging purposes. The concern named solicits prices on material needed on the project. Further information can be obtained from the Portland office.

PORT ANGELES, WASH.—Two concerns have applied to the city council for a franchise to install and operate a street railway system in this city for a period of 50 years. John H. Dalton, Chicago, et al., were first petitioners, which was followed by request of the Olympia Power Company. Both applications were referred to the city attorney and franchise committee.

MARTINEZ, CAL.—February 1 has been set as the day for the opening of regular passenger traffic over the Oakland and Antioch Railway from Bay Point through the Redwood Canyon tunnel to Oakland. At the present rate of progress, 12 to 15 feet per day, the tunnel will be finished by January 10, and several days will be allowed for the operating of heavily loaded dirt trains through the tunnel to settle the roadbed. The rails have been laid up to the east portal of the tunnel, and the sub-contractors have been offered a handsome bonus if they have their work completed by January 10.

SAN FRANCISCO, CAL.—Preliminary steps for a municipal railway in Van Ness avenue from Market street to the bay to furnish transportation facilities to the Panama-Pacific Exposition and act as a cross town line for the Geary street road, have been taken by the Supervisors. To the public utilities committee was referred a resolution which contains an ordinance setting forth that public necessity demands the construction of a municipal double tracked street railway in the avenue, including switches connecting with the Geary street road. The second section of the proposed ordinance directs the Board of Works to furnish within 20 days plans and estimates for the construction of the road.

LOS ANGELES, CAL.—An important step toward the building of the proposed municipal railroad and the relieving of traffic congestion on Main street was taken when the Public Works Board advertised for bids for the construction of the San Pedro street line between Aliso and Ninth streets. This line, which will be the first link in the proposed municipal road to the harbor, will be a three-rail system, affording opportunity for the operation of both broad gauge cars of the Pacific Electric and narrow gauge cars of the Los Angeles Railway Company. Bids will be opened January 10. It is expected that the only bidder will be the Pacific Electric, which has the equipment ready for the work. As soon after January 10 as possible the actual work of constructing the line will be started.

TELEPHONE AND TELEGRAPH.

BELLINGHAM, WASH.—The Government Forest Service will build a telephone line from a point on Baker Creek to old Mazama cabin on the slope of Mt. Baker. Work will begin in the spring.

RIALTO, CAL.—The Pacific Telephone & Telegraph Company has been granted a franchise to transmit electricity for telephone and telegraph purposes in and upon certain streets and public places according to the terms of the franchise.

CHEHALIS, WASH.—G. F. Allen, forest supervisor, Tacoma, has applied to the Lewis county commissioners, for the right to erect a telephone line along certain county roads near and through the forest reserve in eastern part of the county. January 6 was set for the hearing.

ABERDEEN, WASH.—J. A. Chambers, representing a company recently formed which purposes to build 20 miles of telephone line to circle North River country, announces work will begin the first of the year. Line will be connected with the central station of the Pacific Telephone Company here.

VISALIA, CAL.—At a meeting of Woodlake residents and property owners in Visalia the Woodlake Rural Telephone Company was formed. A committee consisting of E. L. Hughes, J. F. Mitchell and Steve Webb was appointed to investigate the cost of the proposed line.

SAN FRANCISCO, CAL.—Complying with a request from the Pacific Telephone Company, the State Harbor Board at a meeting last week granted permission to that company to install three additional telephone booths in the Ferry building to relieve the congestion at the pay station in the south wing.

PORT ANGELES, CAL.—C. J. Farmer, president and general manager of the Angeles Telephone & Telegraph Company, announces that his company will immediately begin the reconstruction, enlargement and improvement of the local telephone system. A new central station and office building will be erected on Fourth street.

ELLENSBURG, WASH.—C. E. Hickman, district commercial superintendent of the Pacific Telephone & Telegraph Company is authority for the statement that 88 miles of telephone line, costing approximately $75,000, will be strung in 1913. The proposed line will be known as the Lind-Ellensburg cut-off and will afford almost a direct line from Spokane to Seattle. Work will be started the first of the year.